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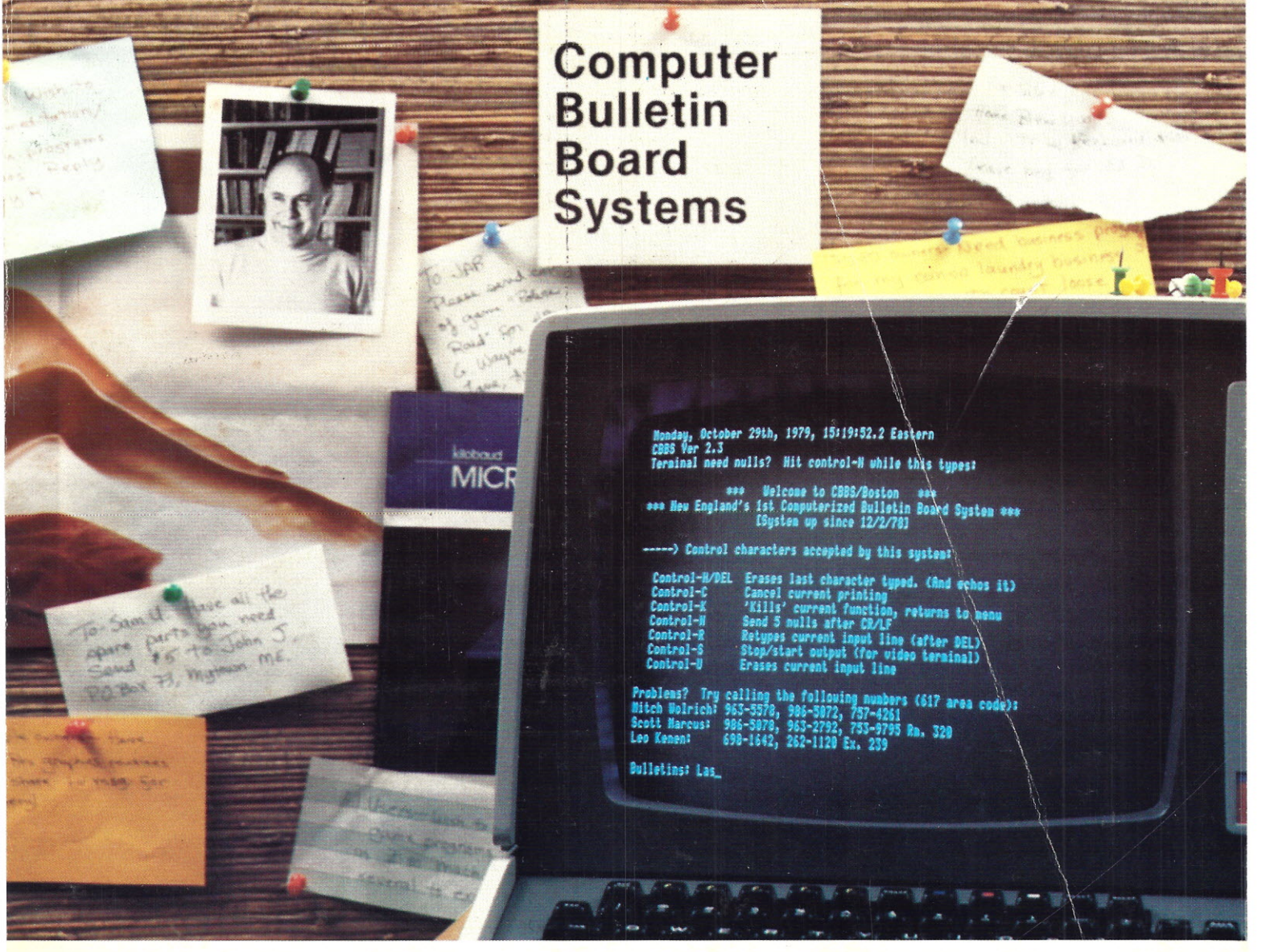

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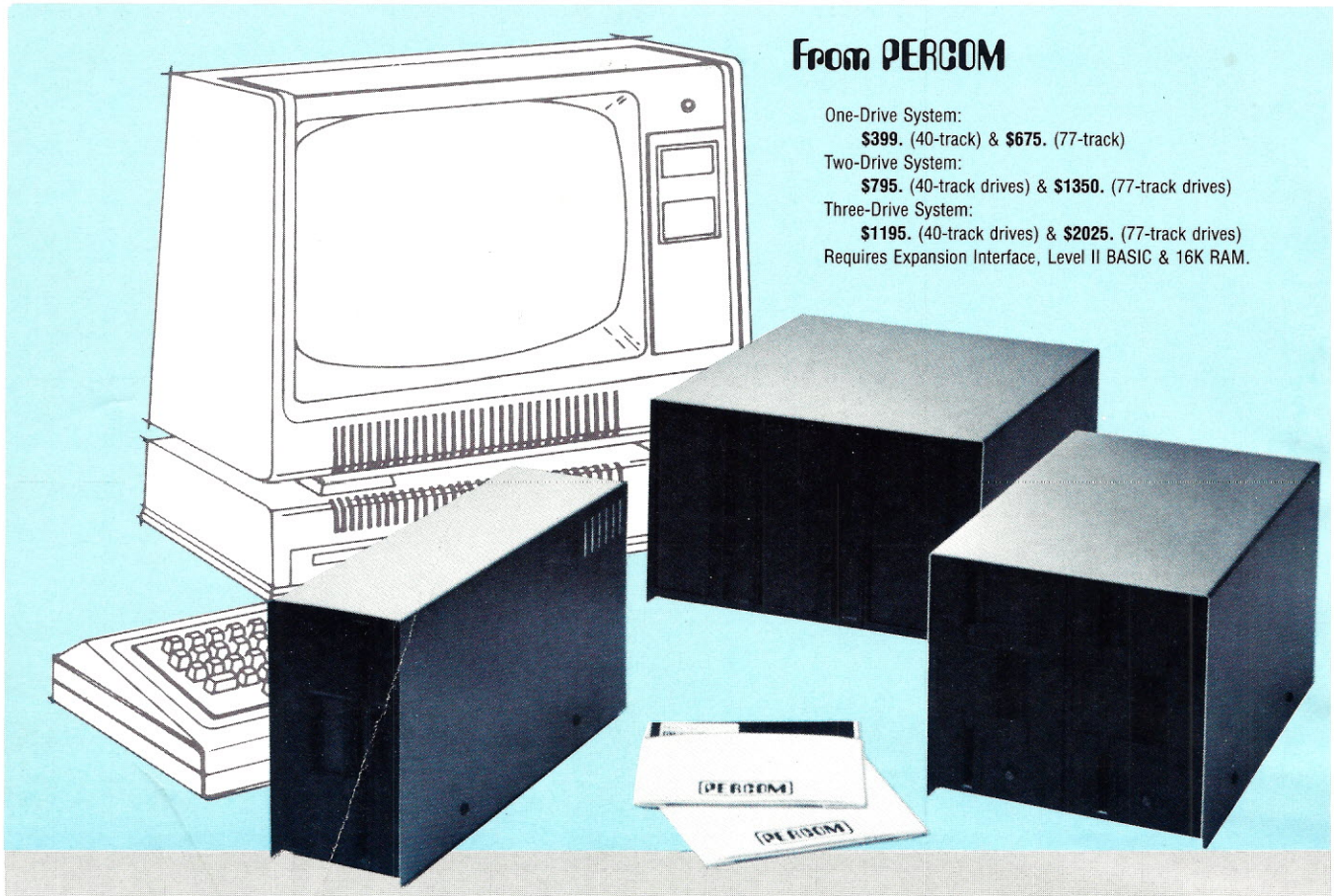

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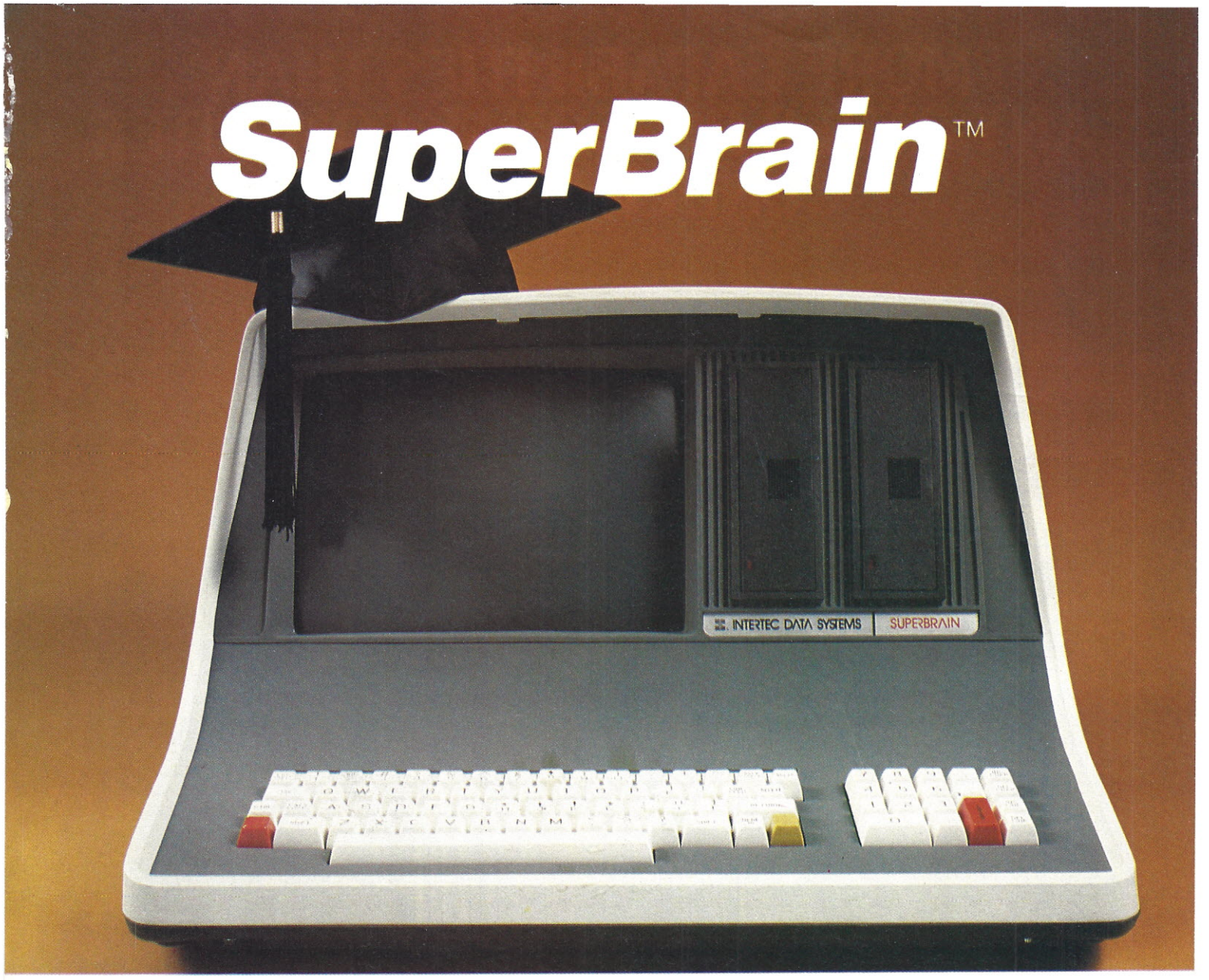

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MICROCOMPUTING™

contents: jan. '80

ARTICLES

DEPARTMENTS

Cover: This month's cover shows CBBS Boston (617-963-8310) dialed up and displayed on a Heath H19. (Photo by Reese Fowler, ISI staff)

micro info

$ This symbol next to a title in the table of contents indicates that the article is a business-application article.

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Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a self-addressed, stamped envelope with each submission. Payment for the use of any unsolicited material will be made upon acceptance. All contributions should be directed to the *Microcomputing* editorial offices. "How to Write for Microcomputing" guidelines are available upon request.

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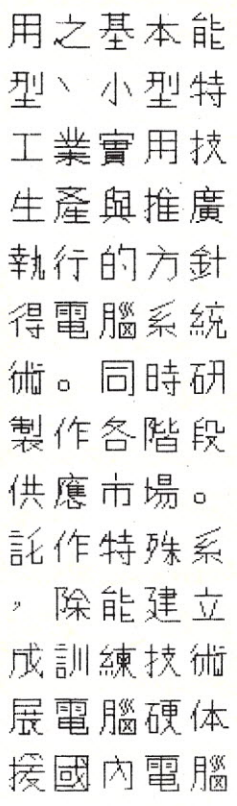
PUBLISHER'S REMARKS

Wayne Green



It takes an 18 by 22 dot matrix to print these Chinese characters. It takes a lot of time to put the characters together and a long time to print them. That the Chinese have been able to cope with their incredible written language with computers is a testimony to man's ability to adapt to almost anything.

Next Year: Asia!

Well, you missed out on a big one. The IEEE sponsored a trip to Asia in October. It was a humdinger. Over 100 people went to consumer electronics shows in Seoul, Osaka, Teipei and Hong Kong. Some went to look for products to sell. Some went with products to be sold in these rapidly growing markets. Some went for the fun of it. No one was disappointed.

The trip, which at well under $2000 for three weeks in several countries was one of the modern-day bargains, included all transportation, hotels and more meals than you might want.

If you sell anything, the cornucopia of products on display at these consumer electronics shows will fire your imagination. And if they don't already have what you want, you can bet that they will be happy to gear up and produce what you need in a few days.

Korea and Taiwan, in particular, are almost desperate for trade and are ready to buy your products or make them for you . . . with government assistance. If you have anything that might sell in China, go to Hong Kong, the great entryway to China.

Sherry and I are planning to take this tour again next year, and I hope that some of you will join us in the fun. We'll set up visits to computer stores and manufacturers and talk with computer clubs.

I'll have more information on this trip in 1980; for now, mark off the first three weeks of October and plan to do some fantastic traveling during this time.

China Has a Big Problem

My recent visit to both Taiwan (Republic of China) and Hong Kong (essentially an adjunct to mainland China) put me in touch with the latest Chinese microcomputer technology. The Chinese have a problem. Their language is incompatible with computers.

I watched two different Chinese character-generator terminals at work. One had hundreds of keys, each with up to five different characters on it, and many characters required the use of two or more keys. This system could generate 10,000 different characters . . . a sort of minimum for writing in the language. Another had a system that built up the characters with as many as seven parts before displaying the complete character . . . again with a 10,000-character library.

The basic problem is that each Chinese character is like one of our words, and the Chinese have no phonetic spelling system. The Japanese do have a phonetic system, called Kana, so they are able to cope with computers. I understand that Singapore, which is 98 percent Chinese, has decreed that the official language of the country will be English within 20 years. It is a little late to invent a Chinese phonetic language, so perhaps the writing of thousands of years should be set aside and English selected for China for the future. This would not be easy.

As China falls behind the rest of the world in computer use, I think the pressure will be on for some solution to the problem. Microcomputers will quickly aggravate this problem by making even small businesses and education dependent on computers. The Chinese are good businessmen, so I think they will see the poster on the wall and realize that something is going to have to give. As deeply as they are rooted in tradition, tradition will have to give way to technology if China is going to be competitive in the future.

Few people are yet aware of the incredible changes that microcomputers are going to make in the world. Those who see what is happening realize that the world will never be the same. In high-technology countries, computers will make it possible for people to be freed from repetitive tasks such as secretarial work, filing and record keeping. Emerging nations will depend on microcomputers for business and education as much as high-technology countries.

Where does this leave a country with no phonetic language? A simple and computer-compatible language is required to cope with the coming changes. Thus I think

Many of the keys have up to five different characters or character components, which can be put together with others to make the finished Chinese characters. The 10,000 characters that can be generated with this system constitute a minimum language, since most Chinese use four to eight times that number of characters when writing.

This Chinese character generator has over 200 keys used to build up a library of over 10,000 different characters.

that China will have to grit its collective teeth and opt for English as a way to accommodate computers.

Recognizing this situation, Instant Software is shipping programs in English to both Taiwan and Hong Kong. The programs being sent to Japan are in both English and Kana. Those going to Korea are largely being translated into Korean.

Practice the Preaching

Can a magazine have too much circulation? I think so, and I'll tell you why. The main problem when circulation increases is that advertising costs also have to go up by the same percentage. When the ad rates go up, smaller firms no longer can afford to run ads. This not only discourages new small firms, it also makes a magazine less interesting. These new firms often have the most progressive products and the best bargains.

With *Kilobaud Microcomputing*'s circulation reaching 100,000, I faced a serious situation. Ad rates, which are based on so many dollars per thousand readers, would have to be increased. One look at the advertising barrenness of high-circulation magazines convinced me that I didn't want to go that route.

The increase in sales and interest in the TRS-80 system made it obvious that TRS-80 information would eventually push out the coverage of other systems in *Microcomputing*. It was also obvious that this would quickly increase the circulation of the magazine to where it would start to freeze out smaller firms. When I started *Byte* my overall plan was for us to build magazines up to a maximum circulation of around 100,000 and then split them according to separate interests to keep down further growth. The easiest split for *Microcomputing* was to start *80 Microcomputing*.

OUTPUT FROM ISI

Sherry Smythe

ISI Sales Reps

You'll be reading more about the developing Asian distribution of Instant Software elsewhere, but the nub of it is that software is now being exported to Japan and will eventually be available in about 100 computer stores there in both English and Japanese versions.

Meanwhile, distribution in the U.S. has been stepped up. More computer stores are joining the Instant Software team; we are projecting over 500 stores associated with ISI by the end of 1979. Dozens of enthusiastic people have been applying for the sales rep jobs, and a network of reps is being established.

Because the key to the success of any publisher lies primarily in marketing, ISI has set up the first rep organization in the microcomputer field. These sales reps go into every computer outlet and make sure that the outlets are aware of the benefits Instant Software will bring.

ISI is also going into every country in the world where microcomputers are sold and making sure that ISI program packages are on hand to help these sales. This brings Instant Software to a world market of well over 600 million people. We have translators setting up our programs in more languages and supporting more systems.

We need more associate editors to help convert our program packages for the Apple and Heath systems. Some of the programs call for extensive graphics conversions, which will be compensated by increased royalties for this work. If you have both a TRS-80 and an Apple, this might be a way to make a nice additional income, one that will come in every month in royalties. Write to me about this.

As I look over the competition, I believe that both our quantity and quality are now tops in the field. As a programmer, your royalties are going to be a direct function of the ability of your publisher to sell, so the bigger the firm you go with, the more sales you can expect. The problem here is that the competition for publication of a specific type of program will be tougher with a large publisher such as ISI, and you could find yourself coming in second to some other programmer. There is much to be said for getting busy—now—and not waiting.

Smaller firms that have tried to market program packages have contacted us to simplify their sales and distribution problems. They have had difficulties with credit, advertising, duplication, packaging, printing documentation and unwillingness of many dealers to try to do business with a hundred small firms instead of one large one. By letting ISI do the marketing, smaller firms can concentrate on writing and developing program packages rather than involving themselves with the endless miseries of marketing and financing.

Warning

If you are a TRS-80 user and have a CTR-80 cassette recorder, be sure to have Radio Shack do a free fix on your recorder so it will not zap your program tapes. We get back a few tapes each month that have been zapped this way, and we replace them for a $1 service charge. But this is a big pain for any computerist, and the recorder should be modified so it will not accidentally erase parts of the program.

One hint: If you do manage to ruin part of a program, check to see if there is a second recording of the program further on down the tape. Most ISI program cassettes have two dumps of the program . . . just in case one gets botched in some way.

Questions and Answers

Some phone callers have wondered why Instant Software doesn't answer questions that have been written in. We do answer, but many programmers include questions with submitted programs. That's a sure way to not get answers. If there are questions, use a separate sheet of paper and envelope so the questions won't go into the program files. Better, address questions to Editor-in-Chief Paul Weiner, Instant Software, Peterborough NH 03458.

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BOOK REVIEWS

Payroll with Cost Accounting in CBASIC

Osborne/McGraw-Hill
Berkeley CA
Looseleaf with binding
364 pages, $15(?)

I indicated the price of the book as "$15(?)" because I wrote the review using an advance copy, prior to publication of the book; hence, I did not know what the exact retail price would be.

The Osborne series of business-program books forms an integrated accounting system composed of three parts: payroll with cost accounting, accounts payable/receivable and general ledger. Each part can be used independently or in conjunction with the others. In this respect the Osborne system is similar to several competing systems. It is dissimilar in another respect: price. The retail prices of comparable products are typically in the $700 range, while the end-user cost for one part of the Osborne system is $15 for the book and another $100 or so for a disk containing the programs.

The first versions of the business-program books used Wang BASIC. The new versions—of which *Payroll* is the first—use CBASIC-2, which is widely available for 8080- and Z-80-based microcomputers. The CBASIC-2 versions are functionally identical to the Wang BASIC versions. To run the programs under the CP/M operating system and the CBASIC-2 compiler, the microcomputer system should have 40K memory, a video terminal with programmable cursor control and a 132-column printer with form-feed (or "top-of-page") control. Substantial disk capacity should be available.

Simplicity is a key feature of the books at the end-user level. Functions are selected from a menu that the programs display on the video terminal. *Payroll* includes 34 primary functions, ranging from file maintenance to report generation. Eight of the functions support the job cost accounting subsystem. Each of the 34 functions is actually a separate program or a separate set of programs. A controlling program—the "menu" program—allows the user to select a function from the menu display; the program for the selected function is then loaded automatically from disk.

Payroll with Cost Accounting —CBASIC (i.e., the book) is divided into eight chapters. The first provides an overview of the system, followed by a list of available functions. Chapter two, "Data Files," explains the file-accessing techniques used. It lists and describes the data files the payroll system maintains. This chapter also includes two useful tables: a cross-reference of which programs use which files and a detailed layout plan of the files.

Chapter three is the "Management Guide." It describes the procedures normally required for successful use of the system. Some procedures are usually performed daily, others monthly, others quarterly and so on. Also described in this chapter are techniques to prevent and recover operator errors.

Chapter four, the "User's Manual," is a 150-page book-within-a-book. Its half-dozen pages of introductory material are followed by detailed instructions for the 34 functions. Each function receives several pages of consideration, including textual discussion, sample program displays and/or printouts and a user flowchart. As with the other sections of the volume, the text of the User's Manual is consistently lucid. General readability is improved by a boldface/lightface format that appears in many other Osborne publications.

Chapter five describes the hardware and software needed for direct use of the CBASIC-2 versions. For those who plan to convert the programs to another dialect of BASIC—or even another language—the chapter next covers the elements of CBASIC-2 that are substantially different from more conventional, interpreted BASICs. Chapter six, "Changing This Payroll," provides useful instructions on how to customize the system.

Chapter seven covers miscellaneous information relating to setup and maintenance of the payroll system: details on common subroutines, disk space mapping, data file creation and CRT mask manipulation. The latter represents a feature of the Osborne systems: display masks are defined centrally and may be modified using a program called CRTFM. The section on CRT mask files is a bit cursory.

The final chapter contains the source listings of the 39 programs and ten common subroutines that form *Payroll*. The listings are large enough to read. They are also amply commented with remark statements. Another documentation aid is the frequent use of descriptive variable names, such as DEDUCTION.AMOUNT and ANNUAL.PAY.

A small question arises: how do you transfer 300K + of listings from the printed page to a computer? You could key them in, perhaps, but that wouldn't be practical. The solution is to make the programs available on disk, which Osborne has done.

The company sells 8-inch, single-density disks containing source listings (.BAS suffix) of the programs. The disks cost $250 per part; payroll, accounts payable/receivable and general ledger are three separate parts. Purchasers of the disks may modify and copy them for resale without royalty. That is, Osborne has defined their copyright to prohibit only human-readable (i.e., printed) reproductions of the programs. (Presumably, you are permitted to generate hard-copy listings for local use, however.)

Other companies have converted the programs to run on other microcomputers and minicomputers. Osborne maintains a referral list for customers who want to obtain conversions for their systems. At this writing, nearly 20 computers are supported by recognized converters. Each converter determines his own price.

The Osborne business-program books seem ideal for the emerging micro-based business system market. Even in comparison to the few competent software packages available today, the Osborne programs are good. And while the books are intended for the implementor who wants to use the published programs, they also form worthwhile models and references for the programmer who wants to develop his own business software. In either case, the Osborne series should prove invaluable.

David Price
Midlothian VA

BASIC with Style

Wagin and Ledgard
Hayden Book Co., Inc.
Rochelle Park NJ
1978, $5.95

BASIC with Style is one of a series of "programming proverbs" books. Other volumes have been published for FORTRAN, COBOL and ALGOL/PL/1. The aim of all of the books in the series is the same: to present and explain a small set of nineteen rules for writing well-structured programs.

BASIC with Style assumes that the reader knows the rules for writing syntactically correct BASIC programs. The point of the book is to teach you how to go from programs that follow the rules of BASIC grammar to programs that are good from the point of view of BASIC style. Style does not mean attractive; it means well thought out and easy to read, check and modify . . . top-down structured programming.

Structured programming is often presented as complicated and executable only in special languages (such as PASCAL or ALGOL) that are not usually available—especially on home computers. True, it is easier to write structured programs in PASCAL, but it can be done in BASIC almost as well. This book shows how. The basic rules presented here are simple: think before you write, write in manageable chunks, comment as you go and check your work. All this is common sense; the book shows how to apply it.

Only on two points do the authors give advice that may not be applicable to personal computing. The first is their heavy stress on desk-checking syntax. This may be important in a batch environment where you wait half a day between the time you submit a program and the time you get it back; in an interactive context, it is much faster to run the program and let your BASIC tell you when you have mistyped something. Computers are much better at routine work than are people!

The second area where the book departs from a personal-computing context is in discussing the establishment of pro-

gramming standards. This is something a programming group does; an individual can set and modify his or her own practices as experience dictates.

In conclusion, *BASIC with Style* is a useful book for someone who has already learned BASIC and who wants to learn how to write programs according to modern ideas of effective programming. Programs written following the recommendations in this book will be easier to write, more likely to work and easier to modify. They will also take up more memory, but that is often a small price to pay for a working program.

John A. Lehman
Ann Arbor MI

The Elements of Programming Style

Kernighan and Plauger

McGraw-Hill, New York, 1974

141 pages, softcover

If you intend to write programs to be used by other people, then you should read this book. If you expect to become a professional programmer, this book is mandatory reading.

The Elements of Programming Style is definitely not an ordinary "how to program" book. In my opinion, there are three distinct differences between this and most programming books.

The first is Kernighan and Plauger's primary concern with the "human factors" of programming: how to write programs that are easier for people to read, understand and use. The authors make the point that if enough attention is devoted to the human requirements in programs, the machine requirements will take care of themselves. To paraphrase the conclusion of chapter 1: The problem with programs people have trouble understanding is not that computers have similar trouble, but that the programs often don't do what they are meant to do.

Addressing the problem of having a program do what it is intended to do, Kernighan and Plauger present 63 "points of style." These range from the generally familiar—"parenthesize to avoid ambiguity," "make sure comments and code agree," "choose a data representation which makes the program simple," "watch out for off-by-one errors"—to the more esoteric—"10.0 times 0.1 is hardly ever 1.0." If any of these rules does not seem obvious, don't worry. As you read the book, every rule is derived from examples that clearly show its application.

The second difference between *Elements of Programming Style* and other programming books is the examples. Every example in this book is a program (or program segment) taken from a published programming textbook. Kernighan and Plauger then improve these programs using the points of style they wish to illustrate.

The authors mention two reasons why they use published programs for their examples: (1) to show the application of the "points of style" to already existing programs rather than present the reader with contrived examples and (2) to learn to write better programs by improving old programs.

This means learning to read critically and to rewrite programs carefully. These examples will convince good-to-average programmers that this book is not just a rehash of known information. I can think of no better book to teach the underlying principles of program development to beginning programmers.

The third difference about this book is a different method of publication. In their examples, Kernighan and Plauger uncover numerous errors, not just in style, but obvious programming errors such as typographical mistakes, misspelled identifiers and transposed statements that would have made it impossible to run the program as given. They also uncover plenty of not-so-obvious errors that should have been caught during testing. In order not to have the same kind of mistakes show up in their book, the authors typeset the book themselves, using a computer-driven typesetting program that allowed them to test the examples directly from the text. While Kernighan and Plauger make no claim that their versions of the programs are "best" in any sense, there is some assurance that they will work as presented.

Elements of Programming Style provides convincing proof that writing programs that are easy to debug, work properly with no hidden failure modes and are easy to use does not have to be a black art. Instead it is possible for anyone who will learn and apply a few basic principles of programming style. The authors also prove that it is possible to make these "better" programs available to a wide audience, with some assurance that the programs are usable as presented. I can testify that a conscientious application of even a few of the principles outlined in this book will make you a better programmer. It is my belief that when a majority of practicing programmers have read this book, the software industry will have taken a long step toward maturity.

Jack W. Reeves
League City TX

Z-80 & 8080 Assembly Language Programming

Kathe Spracklen

Hayden Book Co., Inc.

Rochelle Park NJ

Softbound, 165 pp., $7.95

Assembly-language programming is an exciting pastime. Therefore, I always keep my eye out for new books on the subject. I am especially interested in Z-80 programming since I recently swapped my Sol for a Cromemco Z-2. I sent for a copy of Spracklen's book hoping to capitalize on my 8080 experience and move painlessly up to the Z-80.

I've accomplished my goal, but not without learning a few things that might be of interest to prospective purchasers of this text.

The introduction to *Z-80 & 8080 Assembly Language Programming* states that it is intended for people who have some experience in a high-level language such as BASIC or FORTRAN and want to tackle assembly-language programming. It also says it will provide just about everything the applications programmer needs to know to get the most out of his machine. Let's see how close to those designs the book comes.

Starting with simple decimal-binary-hex mathematics and then moving into a discussion of bits and bytes and CPU flags, the author is beginning at the beginning. To strengthen the learning process, each chapter ends with a series of exercises whose answers can be found in the appendices.

Next come variables, and we're deeply involved in our subject, especially novices with no previous assembly-language programming experience. Unfortunately, at this point, we're only 14 pages into the book. I started feeling early that we were rushing things. Even with my background I'd have liked a little more explanation.

Much of the book discusses the various 8080/Z-80 instructions yet minimizes how to put them to use or even why you'd want to use them. Most of the "how" involves exercises that present programming problems and then use commented source listings as the answer. The information is all there, but I feel that the beginner will have trouble relating the text and the listings to the actual programming task.

In all examples where it is appropriate, 8080, Zilog Z-80 and TDL Z-80 mnemonics are given. In many cases, 8080 programming equivalents to the more powerful Z-80 instructions are listed.

The operation of all the instructions discussed is displayed diagrammatically using symbols I am sure are well known to professional programmers. These symbols are not as well known to computer hobbyists because they do not appear on most keyboards. Symbols such as ≠, ≤ and ≥ would have been more familiar to most of us if presented as <>, <= and >=. Several others, which I still don't know the meaning of, are used.

The final chapter concerns saving the programmer's time and saving processor time. Both are laudable goals. Structured programming is presented as the solution to the first problem, and reducing the number of processor cycles required to complete a task is advocated for the second. I agree in both cases but would have liked more discussion. As with the rest of the book, I felt that we were skimming along.

Am I being too critical? I tried to take the author's word that this text was intended for the person without any previous assembly-language programming experience. However, I don't think it is possible to teach a subject as complex as Z-80 programming from scratch in 102 pages. Add 21 pages to list the 8080/Z-80 instruction sets and 43 pages of exercise answers, and you get 165 pages.

Z-80 & 8080 Assembly Language Programming claims to be ideal for self-study and for schools. I agree that everything necessary to program a Z-80 microprocessor in assembly language is provided, and the book was worthwhile. I just think the material is covered too quickly and without enough practical application.

Rod Hallen
Tombstone AZ

OHIO SCIENTIFIC'S
SMALL SYSTEMS JOURNAL

Introduction

In this month's issue we will be concluding the multi-part series on Ohio Scientific's information management system, OS-DMS. Our objective in this issue is to give the reader a brief description of the final three information management systems: Inventory, Quotation/Estimation, and Testing/Tutoring which have not been shown in our previous articles. Like the past articles, this issue also contains several reports which were generated by these systems so that the reader might better understand the purpose of the system.

OS-DMS QUOTATION/ESTIMATION SYSTEM

The OS-DMS Quotation/Estimation Package, like the other OS-DMS modules, utilizes OS-DMS compatible master files and is specifically designed for a non-computer-oriented user. The system is designed to aid the businessman whose activities involve providing estimates or quotations as a part of his normal business proceedings. It provides a quick and easy method of making these calculations with the ability to generate hard copies for further reference and customer presentation. The package also acts as a prompter by displaying each factor that was previously defined, reminding the user to consider each factor every time the program is run.

Because the user establishes each file and record, he can perform either general or specific estimates. In the case of general estimates, the user would create a file containing all of his inventory and other items, tangible or intangible, needing to be considered. Then, anytime a calculation would be needed, the user would be prompted by each item that was previously entered. That is, each item would appear on the screen before him for confirmation of use in that particular operation.

For specific estimates, the user would create a file containing only the items necessary to perform that particular task. For example, a construction company would create files for building, landscaping, or demolition estimates. Or, the files may be broken down into even more specific functions such as building houses, building garages or building barns. These files may contain such things as materials, carpenter's wages, bricklayer's wages, operating expenses, transportation expenses, fees for permits and overhead expenses.

Below is a copy of the Estimation System Menu.

OS-DMS ESTIMATION

Functions

(1) CREATE NEW ESTIMATION FILE
(2) EDIT ESTIMATION FILE
(3) PERFORM ESTIMATION
(4) ESTIMATION CHANGE AND/OR REPORT
(98) OS-DMS FILE DIRECTORY
(99) EXIT

OS-DMS ESTIMATION SYSTEM OVERVIEW

The following is a short key to the programs on the menu.

CREATE NEW ESTIMATION FILE

This program allows the user to create new estimation files. The user specifies file names, passwords, and the number of records per file. All other specifications, such as the number of fields, the name of each field, and the maximum length of each field, are predefined. The system then creates and initializes the estimation file automatically.

EDIT ESTIMATION FILE

The Edit Estimation File program provides a means of modifying estimation files. The user may specify a record number, an exact entry, or a search 'string' to access a particular record.

PERFORM ESTIMATION

The Perform Estimation program permits the user to run estimates based on the items chosen for the estimate and the usage. Also, while performing an estimate, the user may update the estimate file with relevant changes. In addition, the user has the option of generating the estimate totals, an internal report, or a customer report.

ESTIMATION CHANGE AND/OR REPORT

This is a utility program which is capable of performing two basic functions. First, it allows the user to modify or correct a previously defined estimate. Then, after correcting the estimate, the user may run the corrected estimate without having to re-enter the specifications.

OS-DMS FILE DIRECTORY

The OS-DMS File Directory selectively lists OS-65U files. The user specifies the type of file(s) to display; the program scans through the OS-65U directory and prints out the specified file names.

THE ESTIMATION SYSTEM CAPABILITIES

Because of its ability to perform several special functions, the Quotation/Estimation package can be cost justified by a businessman who performs frequent estimates for projects or products. These functions include the generation of hard copy reports, built-in edit features, reusable estimates, user specified options, and OS-DMS file compatibility. However, a businessman who performs only two or three estimates a year would be better off performing the estimates manually and having his secretary type it.

The following is a brief discussion on each of the functions mentioned above.

1. The OS-DMS Estimation System has the ability to generate two types of hard copy reports: an internal report and a customer report. Generating hard copies of the two reports eliminates having to dictate the estimate form and figures to a secretary and having her manually type the report.
2. There are three methods of editing the estimation files:
   a. During the initialization of each estimate (while running "Perform Estimate") any given item or the prices representing that item may be modified. What this means is that instead of having to manually edit the estimation file, the user can update each entry while running the estimate.
   b. After running an estimate, if for some reason the user decides that the estimate needs to be changed, updates can be made by running the "ESTIMATION CHANGE AND/OR REPORT" program. This program lets the user make the necessary changes and run the estimate again.
   c. The third type of editor is the OS-DMS Editor which allows manual edit functions at any time. The OS-DMS Editor is also the program that is used for the initial entry of data in the files.
3. When running an estimate the user has two options that may be selected:
   a. The user may add a variance to the totals for each heading. If a variance is desired, the user also has the option of specifying the variance as an amount or as a percentage of the totals per heading.
   b. Secondly, the user must specify whether or not to display the profit margin on the customer report and, if so, whether to calculate it on the retail or the wholesale price.
4. The OS-DMS Estimation System is compatible with the other OS-DMS modules. This common bond permits the user to link files, e.g., the estimation files to the inventory files. This compatibility enhances the estimation module considerably because it means that the OS-DMS Nucleus utilities can be used with the estimation programs.

THE ESTIMATION SYSTEM REPORTS

This system produces three types of reports shown below:

The Initial Entry Listing. This report indicates all of the inputs which were used to perform a given calculation.

```
***QUOTATION ESTIMATION*** - (INITIAL ENTRY LISTING)

MASONRY MATERIALS

ITEM                WHOLESALE  RETAIL  UNIT
  CEMENT              6.15      8.00  PER 50 LB. BAG
5
  SAND                2.50      5.00  A TON
2
  GRAVEL              8.00     15.00  A TON
1
  ANCHOR BOLTS         .60      1.50  EACH
8
  WIRE REINFORCING     .95      2.00  PER 50. FT.
58
VARIANCE (Y OR N) Y

IS THE VARIANCE GOING TO BE

   1) AN AMOUNT
   2) A PERCENTAGE
1

AMOUNT OF VARIANCE
3

LUMBER

ITEM        WHOLESALE  RETAIL  UNIT
  1 X 1        .01      .05  PER FT.
  1 X 2        .03      .08  PER FT.
  1 X 4        .04      .12  PER FT.
100
  1 X 6        .05      .15  PER FT.
8
  2 X 2        .05      .15  PER FT.
  2 X 3        .06      .18  PER FT.
  2 X 4        .08      .20  PER FT.
342
  2 X 6        .09      .25  PER FT.
66
  2 X 8        .10      .30  PER FT.
  2 X 10       .12      .35  PER FT.
  2 X 12       .14      .40  PER FT.
  4 X 4        .10      .30  PER FT.
  4 X 6        .14      .40  PER FT.
VARIANCE (Y OR N) N
```

PLYWOOD

ITEM	WHOLESALE	RETAIL UNIT
1/8 INCH	7.40	9.20 A SHEET 4 × 8
1/4 INCH	8.15	10.00 A SHEET 4 × 8
3/8 INCH	9.40	11.20 A SHEET 4 × 8
8		
1/2 INCH	10.55	12.00 A SHEET 4 × 8
5/8 INCH	11.35	13.20 A SHEET 4 × 8
3		
3/4 INCH	12.10	14.00 A SHEET 4 × 8
7/8 INCH	13.85	15.20 A SHEET 4 × 8

The second report is the Internal Report. The Internal Report is a company-oriented report which contains the amount of usage for each item selected, the item, the wholesale and retail prices, how the unit is sold, the totals per item, and the final totals per heading. At the end of the report are the grand totals and the profit margin. The Internal Report is primarily for managerial personnel so that they can analyze it and decide whether or not the estimate is accurate and perhaps whether they should make a bid on the project.

SACKER CONTRACTING INC.
22413 S. GROVE STREET
TONKLE, NEW JERSEY 51227
785-6641

INTERNAL REPORT PAGE 1

DATE: 4/22/79 ESTIMATE VALID UNTIL: 6/22/79
NAME: BOB LINDEN
PROJECT: TOOL SHED
DESCRIPTION: 6 FT. WIDE, 8 FT. LONG & 7 FT. HIGH (BUILD OUT OF WOOD)
MISC.
ESTIMATED TIME OF COMPLETION: 2-3 DAYS

MASONRY MATERIALS

USAGE	ITEM	WHOLESALE	RETAIL UNIT	WHSL TOTAL	RETAIL TOTAL
5	CEMENT	6.15	8.00 PER 50 LB. BAG	30.75	40.00
2	SAND	2.50	5.00 A TON	5.00	10.00
1	GRAVEL	8.00	15.00 A TON	8.00	15.00
8	ANCHOR BOLTS	.60	1.50 EACH	4.80	12.00
58	WIRE REINFORCING	.95	2.00 PER SQ. FT.	55.10	116.00
	VARIANCE	3.00	3.00	3.00	3.00
			TOTAL	106.65	196.00

LUMBER

USAGE	ITEM	WHOLESALE	RETAIL UNIT	WHSL TOTAL	RETAIL TOTAL
100	1 × 4	.04	.12 PER FT.	4.00	12.00
8	1 × 6	.05	.15 PER FT.	.40	1.20
342	2 × 4	.08	.20 PER FT.	27.36	68.40
66	2 × 6	.09	.25 PER FT.	5.94	16.50
			TOTAL	37.70	98.10

PLYWOOD

USAGE	ITEM	WHOLESALE	RETAIL UNIT	WHSL TOTAL	RETAIL TOTAL
8	3/8 INCH	9.40	11.20 A SHEET 4 × 8	75.20	89.60
3	5/8 INCH	11.35	13.20 A SHEET 4 × 8	34.05	39.60
			TOTAL	109.25	129.20

LABOR

USAGE	ITEM	WHOLESALE	RETAIL UNIT	WHSL TOTAL	RETAIL TOTAL
12	CARPENTER	10.40	20.00 AN HOUR	124.80	240.00
4	MANUAL LABORER	8.60	15.00 AN HOUR	34.40	60.00
			TOTAL	159.20	300.00

MISC. MATERIALS

USAGE	ITEM	WHOLESALE	RETAIL UNIT	WHSL TOTAL	RETAIL TOTAL
1	TAR PAPER	6.65	8.40 A ROLL	6.65	8.40
3	SHINGLES	18.10	21.20 A BUNDLE	54.30	63.60
2	NAILS	3.25	4.50 A LB.	6.50	9.00
			TOTAL	67.45	81.00

RETAIL PRICE IS $804.30
WHOLESALE PRICE IS $480.25
PROFIT MARGIN IS $324.05

Finally, the Customer Report is similar to the Internal Report, except that it does not display any of the wholesale numbers and the user must specify whether or not to display the profit margin on the report. If the profit margin is on the report, the user must also specify whether the profit margin should be calculated on the wholesale or retail cost and, unlike the Internal Report, the profit margin is displayed as a percentage.

SACKER CONTRACTING INC.
22413 S. GROVE STREET
TONKLE, NEW JERSEY 51227
785-6641

CUSTOMER REPORT PAGE 1

DATE: 4/22/79 ESTIMATE VALID UNTIL: 6/22/79
NAME: BOB LINDEN
PROJECT: TOOL SHED
DESCRIPTION: 6 FT. WIDE, 8 FT. LONG & 7 FT. HIGH (BUILD OUT OF WOOD)
MISC.
ESTIMATED TIME OF COMPLETION: 2-3 DAYS

MASONRY MATERIALS

USAGE	ITEM	COST UNIT	TOTAL	
5	CEMENT	8.00 PER 50 LB. BAG	40.00	
2	SAND	5.00 A TON	10.00	
1	GRAVEL	15.00 A TON	15.00	
8	ANCHOR BOLTS	1.50 EACH	12.00	
58	WIRE REINFORCING	2.00 PER SQ. FT.	116.00	
	VARIANCE	3.00	3.00	
			FINAL TOTAL	196.00

LUMBER

USAGE	ITEM	COST UNIT	TOTAL	
100	1 × 4	.12 PER FT.	12.00	
8	1 × 6	.15 PER FT.	1.20	
342	2 × 4	.20 PER FT.	68.40	
66	2 × 6	.25 PER FT.	16.50	
			FINAL TOTAL	98.10

PLYWOOD

USAGE	ITEM	COST UNIT	TOTAL	
8	3/8 INCH	11.20 A SHEET 4 × 8	89.60	
3	5/8 INCH	13.20 A SHEET 4 × 8	39.60	
			FINAL TOTAL	129.20

LABOR

USAGE	ITEM	COST UNIT	TOTAL	
12	CARPENTER	20.00 AN HOUR	240.00	
4	MANUAL LABORER	15.00 AN HOUR	60.00	
			FINAL TOTAL	300.00

MISC. MATERIALS

USAGE	ITEM	COST UNIT	TOTAL	
1	TAR PAPER	8.40 A ROLL	8.40	
3	SHINGLES	21.20 A BUNDLE	63.60	
2	NAILS	4.50 A LB.	9.00	
			FINAL TOTAL	81.00

ESTIMATED PRICE IS $804.30
PROFIT MARGIN IS 40.28%

OS-DMS TESTING/TUTORING SYSTEM

Today, the educational challenge is great! That is why instructors are constantly searching for learning aids and better methods of teaching. Instructors have found that if some types of audio-visual aids are used, students tend to learn more quickly and easily. Examples of such aids are slides, films, field trips and, the newest and latest audio-visual aid, the computer.

With our ever-growing technology, scientists are constantly discovering new tasks the computer can perform. The computer promises to turn the day to day operations into a lifetime learning process.

To aid the teacher in the classroom, Ohio Scientific has developed the OS-DMS Educational System. It is designed to allow a teacher who is not trained in the use of a computer to quickly and efficiently set up a quiz or tutorial session, have the students do the required work on the computer, and then give the student a grade and record the grade automatically. Additionally, it allows the teacher to define practically any type of test or lesson desired, depending on the program specifications defined.

The OS-DMS Educational System is obviously not a business package, but it could possibly be tied in with our business applications. For example, a school could purchase the Educational System to be used by all the instructors as an aid in tutoring and giving quizzes. If the Educational System seemed to be a success with the students and the instructors, the school could then purchase the Account Payable/Receivable, Personnel, General Ledger, and possibly the Inventory system. By setting up model accounts and companies on these systems, the students in the business courses such as general business, bookkeeping, accounting, etc., can get first-hand experience in real life situations. Because the OS-DMS modules are systems that are written for real life applications, the school could additionally use these systems for their own purposes.

The following is a copy of the Instructor's Menu:

OS-DMS EDUCATIONAL SYSTEM

Functions

(1) CREATE A GRADE FILE
(2) CREATE A QUIZ OR TUTOR FILE
(3) REVISE A QUIZ OR TUTOR FILE
(4) REVIEW A GRADE FILE
(5) SCORE CONFIRMATION
(6) DMS FILE DIRECTORY
(98) RETURN TO THE STUDENT MENU
(99) EXIT

OS-DMS EDUCATIONAL OVERVIEW

The following is a short key to the programs on the Instructor's Menu.

CREATE A GRADE FILE

This allows the instructor to create Grade Files. The Grade File contains the name of each student, student number, the total number of possible points for each quiz, the number correct and the number incorrect. The instructor specifies the device the file is to be stored on, the file name, the password, and the number of students to be included in the file.

CREATE A QUIZ OR TUTOR FILE

Before a quiz or tutor can be written, the instructor must create Quiz or Tutor files. The Quiz and Tutor files are similar except that the first letter of a quiz must begin with a "Q" and the first letter of a tutor must begin with a "T". Both contain the questions, the answer to each question, two miscellaneous fields and the points that each question is worth. The instructor specifies the device the file is to be stored on, the file name, the password, whether this is a Quiz or Tutor file, the number of questions, and the maximum number of lines to reserve for each question.

REVISE A QUIZ OR TUTOR FILE

This program provides a means of editing Quiz and Tutor files. It also has other built-in features such as the ability to generate a hard copy of a quiz or tutor, allowing the instructor to erase an entire Quiz or Tutor file and permitting him or her to set certain specifications for a Quiz or Tutor file.

REVIEW GRADE FILE

This program provides editing features, permits easy retrieval of student scores, has the ability to append and delete students, and can generate a printed listing of all the students and their scores.

SCORE CONFIRMATION

After the deadline for taking a quiz has passed, the instructor is required to run this program. This program looks in the Grade File to see what students have not taken the quiz. Whenever a student does not have a score recorded for the latest quiz, the program gives that student a zero for the quiz score, and displays a list of the students who did not take the quiz.

THE EDUCATIONAL SYSTEM CAPABILITIES

The OS-DMS Educational System was designed to assist instructors in two primary areas of teaching: tutoring and testing. Both have several special built-in features which make the Educational System quite unique. Since all instructors do not give tutors and quizzes in the same fashion, these features are essential because they allow the teachers to individualize their lessons and quizzes.

The following is a brief discussion on each of the features for a tutor and a quiz.

TUTOR

Tutors can be used for a wide variety of applications. Some instructors might use the tutoring program to assist those students that are having difficulty in their classes, others might use it to test one's knowledge and others as a review for finals.

The operational decisions to be made by the instructor when setting up a tutorial session are as follows:

1. Specify whether or not Structured Learning should be used.

Structured Learning is a tutoring program specifically designed to use multiple choice and/or matching questions. Structured Learning reviews any particular topic: i.e., the capital of each state or the presidents of the United States. The program begins by displaying the first question with four possible choices. If an incorrect answer is chosen, the program will tell the student why the answer he chose was wrong and will ask the same question again. This process will continue until the question is answered correctly.

Note:

A Tutor file established for Structured Learning must pertain to one particular topic throughout the file; the program randomly selects three answers from any question in the file. If the file does not pertain to a particular topic, the three answers selected may not relate with the question.

2. Select the Input/Output (I/O) device.

If a line printer is available, the instructor has the option of generating a hard copy of the questions, the student's answers and the student's score. The purpose for generating a hard copy of the tutor is to supply the student with a study sheet as a review for finals or to give the instructor written results of how much his students have remembered from a past quiz or lesson.

3. Specify whether or not the student should have a second chance to answer each question correctly.

4. Specify whether or not the student should be told the correct answer after the question has been answered incorrectly.

5. Specify whether the student should be shown the score.

6. If a Level III machine is available, the instructor may specify a time limit for the tutor.

QUIZ

Like tutors, quizzes also can be written and used in a variety of ways. Because of this, the quiz program also has several built-in features. Unlike the tutor, however, when a quiz is being run, the program automatically checks if the student taking the quiz has taken it before. It also checks to see if the student number exists. If the student has taken the same quiz before or the student number does not exist, the program will inform the student that he cannot take the quiz and will exit the system. Also, after a quiz has been taken, the program automatically writes the student's score in the student grade file.

The operational decisions to be made by the instructor when setting up a test are as follows:

1. Select the Input/Output (I/O) device.

Since the student's answers to individual questions are not recorded anywhere, the instructor might want to generate a hard copy of each student's quiz. Later, after the quiz, the instructor could distribute the quiz papers and go over the questions with the students.

2. Specify whether to display the questions randomly or sequentially.

This feature helps eliminate possible cheating by students. If the questions are scrambled for each student, the passing of answers would be useless unless the student wrote down each question and the answer to it.

3. Specify whether the student should be shown his score.

4. If a Level III machine is available, the instructor may specify a time limit for the quiz.

THE OS-DMS INVENTORY CONTROL SYSTEM

The OS-DMS Inventory Control System is an automated computer system designed to provide the end user with specific information concerning the current status of the inventory. This system is menu oriented so only minimal computer knowledge is needed.

There are three sub-systems which make up the Inventory Control System: the Inventory System, the Purchasing System, and the Bills of Material System. These subsystems were designed to run independently or in an integrated mode. If a particular end user is using all three systems, data may be passes from one to the other. This allows the end user to slowly integrate computerized operations into the business without sacrificing the benefits of integrated business software.

INVENTORY SYSTEM

The Inventory System enables the inventory control clerk to accurately keep track of the current inventory levels and value. This is accomplished by providing the functions shown on the following menu:

OS-DMS INVENTORY MENU

(1) CURRENT QUANTITY IN STOCK REPORT
(2) INVENTORY USAGE STATUS REPORT
(3) REORDER REPORT
(4) CURRENT INVENTORY VALUE REPORT
(5) ARCHIVE INVENTORY REPORT
(6) GENERAL CONDITIONAL INVENTORY REPORT

(7) ORDER ENTRY
(8) STOCK CHECK
(9) RELIEVE OR SHIP ITEMS FROM INVENTORY
(10) RECEIVE ITEMS INTO INVENTORY
(11) UPDATE CURRENT QUANTITY IN STOCK VALUES
(12) GENERAL INVENTORY EDIT

(13) SET A REORDER LEVEL
(14) SET AN AVERAGE USAGE
(15) ALPHABETIZE INVENTORY RECORDS
(16) COPY OR BACKUP DISKETTES
(99) EXIT

?

These functions can be divided into three areas: the report writers, the day to day operations, and the maintenance functions.

The report writers are used to inform management of the status of the inventory. The Inventory Usage Status Report provides detailed information such as average weekly usage, weeks on hand and weeks on order for each inventory item. The Inventory Value Report calculates the current value of the inventory using the average unit costs. A general report writer is included to handle the occasional reports that are requested.

The day to day operations such as stock checks, entry of received goods and inventory adjustments have been optimized for maximum speed and accuracy. A record is made of all input transactions to aid in the correction of input errors. The order entry program will mark items ordered and generate an invoice.

The maintenance functions allow the end user to make copies of the inventory data in case an error occurs, and to keep the inventory master file in alphabetical sequence. Again, the programs prompt the user with simple, easy to understand instructions.

Throughout the OS-DMS business systems, the amount of computer knowledge the operator needs has been kept to a minimum. This means that any person capable of performing the same business task manually will be able to use this software with minimal instruction.

There are several features that help make this Inventory System useful to the small businessman.

The system maintains an average weekly usage for all items in the inventory. When a stock check is performed, the computer provides a detailed description of the item's current status. The average weekly usage is used along with the quantity in stock and quantity on order values to obtain weeks on hand and weeks on order figures. The current average unit cost is used to determine the value of the inventory. With this data, the inventory clerk has a more informative picture of the state of inventory than a simple quantity in stock report or a reorder report.

PURCHASING SYSTEM

The Purchasing System keeps track of the open purchase orders for inventory items. The purchasing clerk can quickly determine if a particular part is on order and, if so, with which vendors. The Overdue Order Age Analysis will list the purchase orders that are overdue. The Outstanding Order Age Analysis will list all currently outstanding purchase orders.

If a particular end user has the Inventory System and the Purchasing System, they may be integrated. Each system will remain independent in that minor changes to the operation of the Purchasing System will not interfere with the Inventory System. The Purchasing System is capable of posting the quantity on order for each item into the Inventory System. With these figures, the Inventory System can generate an inventory value report with the dollar value on order for each part. When a part is received by the receiving clerk and entered into the Inventory System, the Inventory System increments the quantity in stock field and decrements the quantity on order figures.

INVENTORY SYSTEM

OS-DMS PURCHASES MENU

(1) PURCHASES MASTER UPDATE
(2) PRINT/DISPLAY PURCHASES JOURNAL
(3) COMPLETE PURCHASES MASTER DUMP
(4) CONDITIONAL PURCHASES MASTER DUMP
(5) PURCHASES MASTER EDIT
(6) PRINT AGE ANALYSIS—OVERDUE ORDERS
(7) PRINT AGE ANALYSIS—ALL OUTSTANDING ORDERS
(8) CREATE NEW PURCHASES MASTER FILE
(9) PRINT PART NUMBER LIST
(10) BACKUP PURCHASES MASTER FILE

(11) EXIT PURCHASES SYSTEM

?

BILL OF MATERIAL AND EXPLOSION FUNCTIONS

(1) INTRODUCTION.

(2) EXPLOSION INPUT FUNCTIONS.
(3) EXPLODE ITEMS ALREADY ENTERED.
(4) EXPLOSION OUTPUT FUNCTIONS.

(5) LIST ALL SUBASSEMBLIES THAT CAN BE EXPLODED.
(6) LIST A BILL OF MATERIAL FOR A SUBASSEMBLY.

(7) CREATE A BILL OF MATERIAL FILE.
(8) EDIT A BILL OF MATERIAL FILE.
(9) DELETE A BILL OF MATERIAL FILE.

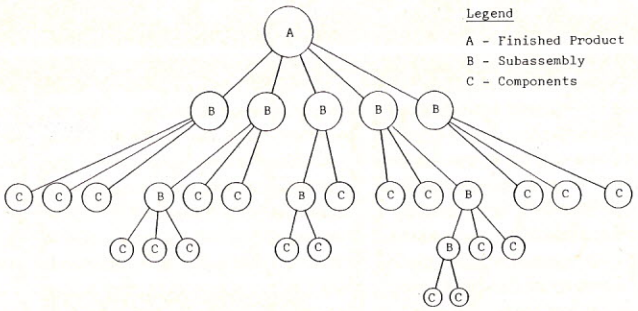
(10) CREATE A COPY OR BACK UP A DISKETTE.

?

BILLS OF MATERIAL SYSTEM

The Bills of Material System allows for the creation, modification and deletion of bills of material for inventory subassemblies as well as the automatic breakdown of subassemblies into their component parts. The functions are selected through a menu system.

Before a part breakdown or explosion can be run, the end user must enter a bill of material for every item that can be broken down. Once these bills have been entered, the end user can have the computer break down finished goods and subassemblies into their component parts. The maximum number of levels of breakdown or explosion for a particular item depends on the number of levels in the bills of material for that item. For example, a particular business manufacturer's television set has twenty subassemblies itemized on its bill of material. If each of the twenty sub-assemblies has a bill of material, the system can do a two-level breakdown. It is common to have another bill of material for most or all of the items on each of the sub-assemblies' bills of material. This would permit the system to perform a three-level breakdown or explosion. This can be expanded to whatever depth the end user desires. The following is a multi-level breakdown.



When a part breakdown is finished, the end user can direct the computer to either increment or decrement an inventory file with the results of the breakdown or print the results in alphabetical order on the terminal or printer. This system provides a means of tracking inventory items that cannot be easily counted manually. The weekly shipping list can be broken down or exploded into raw inventory components. These figures could be used to adjust the quantity in stock figures for those items.

The Bills of Material System can be integrated into the Inventory Control System. When a bill of material is being printed, the end user has the option of having the computer look at the inventory file for the description and the latest average unit cost for each component on the bill. This means that the bill of material will have the latest and most accurate description and price. This eliminates the need for the double entry of data when the cost or description changes.

EXPLOSION FILE DUMP PAGE: 1

PART NUMBER: CA-6CP
DESCRIPTION: GENERAL PURPOSE I/O—MEMORY BOARD

PART NUMBER	QUANTITY	DESCRIPTION	TOTAL COST
PC-61	1	ACCESSORY BOARD	16.42
SC-12MM	2	12 PIN MA MOLEX PLUG 09-64-1121	.27
SC-16FI	10	16 PIN INTEGRATED CIRCUIT SOCKET	1.20
SC-18FI	48	18 PIN INTEGRATED CIRCUIT SOCKET	6.96
SC-24FI	1	24 PIN INTEGRATED CIRCUIT SOCKET	.18
SC-40FI	3	40 PIN INTEGRATED CIRCUIT SOCKET	.89
C-151	2	150 PF.	.10
C-102	2	.001 MF.	.14
C-506	2	50 MF.	.16
CB-10410	39	.1 MF. BYPASS 10 VOLT	1.70
R1-102	4	1K OHMS 1/4 WATT 5%	.04
R1-221	12	220 OHMS 1/4 WATT 5%	.12
R1-391	12	390 OHMS 1/4 WATT 5%	.12
R1-471	8	470 OHMS 1/4 WATT 5%	.08
R1-472	2	4.7K OHMS 1/4 WATT 5%	.02
RP-103	4	10K OHMS TRIMMER POT.	1.64
IC-74LS00	1	TTL	.21
IC-74LS04	2	TTL	.33
IC-74LS02	1	TTL	.16
IC-74LS10	1	TTL	.14
IC-7417	4	TTL	.76
IC-74LS20	1	TTL	.23
IC-74LS93	1	TTL	.26
IC-74123	2	TTL	.64
IC-74LS138	4	TTL	1.40
IC-74LS390	3	TTL	2.13
IC-8T28	2	BUFFER	1.62
IC-8T95	3	BUFFER	1.89
IC-68B50	1	PIA	4.00
IC-68B21	1	PIA	4.00
IC-L2114-550	32	RAM	116.80
HW-SP.75	4	PLAS. SPAC. 3/4 L. SMITH 4167	.12
HW-WAN	8	NYLON WASHER HH SMITH 2673	.09
HW-S6321.25	4	SCREW 1-1/4 × 6-32	.04
W-406J	1	40 COND 6" L. FL CA JUMP AP PROD	4.52
W-1ST18	1,FT.	1 CONDUCTOR STRANDED 18 GA.	.03
SC-3FC	1	3 PIN FE MOLEX CON 03-09-1032	.05
SC-1FTM	2	FEM. TERM/MOL. 02-09-1118	.02
SC-1MTM	2	MALE TERM. MOL. 02-09-2118	.02

SUMMATION OF TOTAL COSTS USING CURRENT INVENTORY AVERAGE UNIT COSTS = 169.50

SUMMARY

The OS-DMS Inventory Control System is comprised of three independent subsystems: the Inventory System, the Purchasing System, and the Bills of Material System. These systems may be run in an independent or integrated mode depending on the degree of sophistication the end user desires. The overall system is flexible enough that it can be implemented in stages to allow the end user time to adjust to computerized business methods. These three systems, when combined with the other OS-DMS business packages, represent a major step in the development of efficient, easy to use microprocessor-based business software.

PET-POURRI

Robert W. Baker

This is my first issue as author of the PET-pourri column; I hope to continue providing interesting and useful information on the PET. With only a week to assemble this first installment, I didn't have enough time to gather much information on new products. By the next issue, I hope to find more products to review, or at least be able to provide more information.

I've been requested to review more programs and hardware accessories for the PET whenever I can acquire them for evaluation. Since most PET owners still buy via mail order, I'll try to provide as much information as possible on each product I learn of or try on my own system. This should make it easier to choose the items of greatest interest for your particular system. It has been suggested, however, that I avoid reviewing game programs unless they are extraordinary.

I'll also try to include programming tips and ideas that I feel may be of value. If you'd like to share any of your own programming tricks or newfound secrets of the PET operating systems, I'd be happy to hear from you. I have one request: Please enclose an SASE if you expect a reply. *All mail should be addressed directly to me and not through the magazine to avoid forwarding delays.*

New Products and Publications

A new printer manufactured by Shinshu Seiki is available for the PET, and it appears similar to the Commodore printer. The Model TX-80 dot-matrix impact printer operates at 150 characters per second. It is available with friction feed or tractor feed and uses standard paper, four to ten inches in width. With 80 characters per line, double-size characters and PET graphics, it appeared to be a nice unit when displayed at PCC '79 in Philadelphia last fall. The printer has been advertised under several names and at varying prices, but lists for about $900 with tractor feed and all interface cables for the PET.

If you have an 8K PET and still haven't replaced your small keyboard, I suggest you check the article in the October 1979 issue (page 82) on the keyboard from Century Research & Marketing. Having used one for several months, I've discovered I like the keyboard with the molded-in graphics and expanded numeric pad.

The *PET Gazette* has become a full-size, bimonthly magazine called *Compute, the Journal for Progressive Computing*. The magazine is divided into four sections:

- 6502 section with articles of interest to everyone with a 6502-based machine.
- Business and industrial applications.
- Educational guide to teachers.
- Gazettes for each "special" machine, including the PET, Apple, Atari and single-board computers (SBCs).

Mail-order subscriptions are $9 per year, and the magazine is published by Small Systems Services, Inc., 900 Spring Garden St., Greensboro NC 27403. The sample issue distribued at PCC '79 was impressive; hope they keep up the good work.

Both Instant Software, Peterborough NH, and New England Electronics (NEECO), 679 Highland Avenue, Needham MA 02194, have been distributing new catalogs. If you haven't received one yet, I suggest you write for one soon. NEECO's General Ledger program is available; I hope to have details on it in time for the next issue.

What About the Axiom Printers?

Although the Axiom electrostatic printers for the PET have been available for over a year, there has been very little mention of these printers in most PET publications or columns. Two models of interest to PET owners offer uppercase and lowercase alphanumerics as well as all PET graphics. The EX-801 PET model is a general-purpose printer, while the EX-820 PET model provides true reproduction of the PET graphics by eliminating extra spacing between printed lines, as occurs on the EX-801. The small, quiet printers have a print speed of 120 *lines* per minute. They were designed to require a minimum of maintenance, and the printhead should last for one to two million lines of printing. This is roughly equivalent to about 140 rolls of paper; a replacement printhead is available for $45.

The printers provide functions that are selected using various control characters as follows:

LIST MODE, CHR$(9) —

All cursor controls are printed as shown on a normal screen listing. This is the mode selected automatically at power-on or online and is used for printing BASIC program listings.

PRINT MODE, CHR$(8) —

All output is printed as it would be displayed on the screen during program execution. Cursor right and SPC commands produce printed spaces, while other cursor controls are ignored. TABs and number formatting using the comma may not produce correct results.

40 COLUMN, CHR$(12) —

Selects 40-column printout, which is normally selected automatically at power-on.

80 COLUMN, CHR$(11) —

Selects 80-column printout until 40-column printout is re-selected. Character sizes may be intermixed in any combination on a line however desired by switching back and forth between the two sizes.

GRAPHICS, CHR$(15) —

Prints PET graphics and uppercase letters providing printout compatible with the POKE 59468,12 mode on the PET.

LOWERCASE, CHR$(14) —

Prints lowercase alphabetic in place of graphics the same as a POKE 59468,14 on the PET. Character types may be intermixed on a line by switching modes back and forth if graphics are desired along with uppercase and lowercase letters.

BELL, CHR$(7) —

Sounds the internal buzzer for 1/4 second when the line is printed containing this control mode.

Two other control characters are listed in the manual to turn the loudspeaker on and off for direct program control of sound ef-

```
10 REM TAPE HEX DUMP PROGRAM
20 REM  BY: ROBERT W. BAKER
30 REM
40 REM DISPLAYS A HEX DUMP OF
50 REM TAPE DATA FILES.
60 :
70 H$="0123456789ABCDEF"
80 PRINT"■TAPE HEX DUMP"
90 PRINT:PRINT:PRINT"HIT ANY KEY TO"
100 PRINT"HOLD/CONTINUE THE DISPLAY."
110 PRINT:PRINT"HIT 'D' WHEN DONE TO"
120 PRINT"STOP BEFORE END OF FILE."
130 PRINT:PRINT
140 OPEN 1
150 S$="      "
160 PRINT"■TAPE HEX DUMP":PRINT:PRINT
170 B=0:GOTO 250
180 GET#1,C$
190 IF ST <> 0 THEN 320
200 A=ASC(C$):A1=INT(A/16)
210 PRINT MID$(H$,A1+1,1);
220 PRINT MID$(H$,A-(A1*16)+1,1);" ";
230 B=B+1
240 IF INT(B/10) <> B/10 THEN 270
250 PRINT
260 PRINT RIGHT$(S$+STR$(B),5)": ";
270 GET C$:IF C$="" THEN 180
280 IF C$="D" THEN 320
290 GET C$:IF C$="" THEN 290
300 IF C$="D" THEN PRINT:END
310 GOTO 180
320 PRINT:PRINT:PRINT"ST =";ST
```

Listing 1. Tape hex dump program.

fects.

I've not been able to make this work, and no information is provided on how to use the controls. The printers do provide automatic printing on the reception of the 81st, 41st or equivalent character, depending on the line characteristics.

The IEEE interface board mounts on the back of the PET at the IEEE bus connector with a ribbon cable connected to the printer. The interface board provides a true IEEE bus connector in addition to reproducing the IEEE edge connector of the PET for other Commodore products. The printer is connected via the IEEE interface but will recognize any device address on the IEEE bus. This was probably done to eliminate the costly circuitry to recognize a specific device address on the IEEE bus and keep the printer cost at a minimum. However, a switch on the front panel of the printer does allow the user to put the printer on or off line to avoid this problem of recognizing all bus addresses.

Two other switches on the printer provide manual paper feed and a built-in self-test mode. When the printer runs out of paper, the bell will sound continuously and all printing will stop.

Having used an EX-801 for over six months now on my own system, I've been impressed by the print quality and the printer reliability. Having the capability of producing true listings of BASIC programs with all cursor controls shown has saved many hours of work on several occasions. My only dislike is the 5 1/2 inch wide electrostatic paper that costs about $6 per roll and can be hard to find on occasion . . . probably the major drawback of this type of printer. However, a 300-foot roll of paper usually lasts for well over a month on my system, even with very heavy use.

If the impact printers are too expensive for your current budget, but you definitely need a printer, you should consider the $495 EX-801 Axiom printer, with the ability to get true program listings compared to other low-cost printers that do not print all PET graphics. If you do decide to get an Axiom printer, make sure you get a model designed for the PET with the IEEE interface. Axiom markets a complete line of printers, and the PET models have a special internal ROM in addition to the IEEE interface to provide all the particular features for the PET.

Programming Ideas and Tips

If you are experimenting with tape data files, this simple program (Listing 1) can help display the exact contents of any data file. It reads the file byte-by-byte and displays the hexadecimal value of each byte in the file, including all separator and control characters. The display will list ten bytes per line with a byte count indicated in the left column, which makes it extremely easy to determine the exact format of any data file.

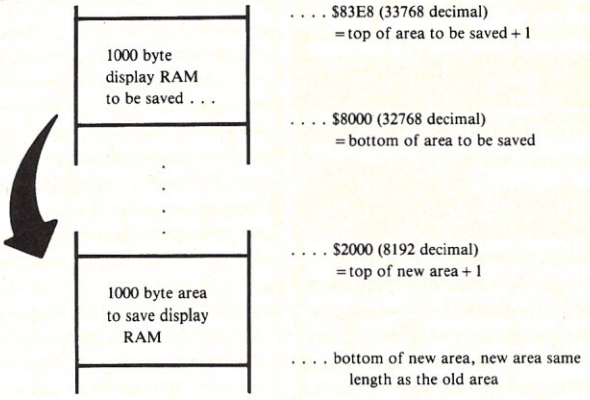
Machine-language programmers might be interested in the following two routines that are contained in the older 8K PET operating system. I plan to check where these routines are located in the new operating system in the near future. I should be getting my new ROM set any day.

Block Move: This routine will move the contents of a contiguous block of memory locations from one area of memory to a new area of memory. The routine starts at hex location $C2E1 (49889 decimal) and uses the following pointers in low memory, which must be set prior to calling this subroutine.

$A9 = hex $E8 (232 decimal)
$AA = hex $83 (131 decimal) . . . . top address = hex $83E8 (33768 decimal)

$AE = hex $00
$AF = hex $80 (128 decimal) . . . . bottom address = hex $8000 (32768 decimal)

$A7 = hex $00
$A8 = hex $20 (32 decimal) . . . . new top address = hex $2000 (8192 decimal)



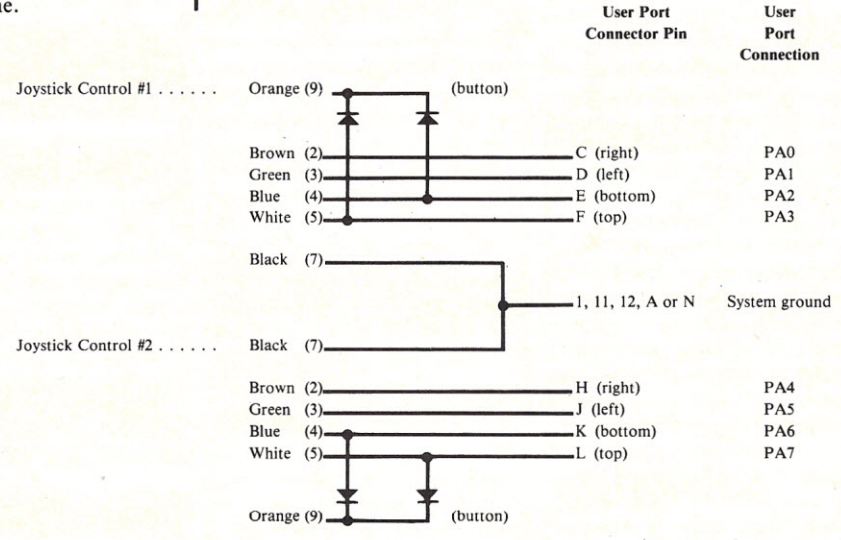
Example 1.

Hex locations $A9 and $AA (169 and 170 decimal) contain the address, plus one, of the last byte to be moved, the upper limit of the old area. Hex locations $AE and $AF (174 and 175 decimal) contain the address of the first byte to be moved, the lower limit of the old area. Hex locations $A7 and $A8 (167 and 168 decimal) contain the address, plus one, of the last byte to be moved to, the upper limit of the new area. All address pointers are in the standard format of the low byte of the address first then the high byte of the address.

As an example, suppose you wanted to move the 1000 bytes of the display RAM into the top of your 8K program RAM to save the data for some reason. Before calling the block move subroutine you would set the pointers as shown in Example 1.

Search for a BASIC Line Number: This routine will search through all the lines of a BASIC program in memory looking for a specific line number. The line number to be found must be placed in locations 8 and 9 prior to calling this subroutine at hex location $C522 (50466 decimal). The line number is stored in standard address format, low byte first. On return from the subroutine, the processor carry bit will indicate whether the line number was found or not. The carry bit will be clear (0) if the line was not found. If the line was found the carry bit will be set (1) and hex locations $AE and $AF (174 and 175 decimal) will

Connector pin	Wire color	Joystick function (switch)
1	***no connection***	
2	Brown	Right
3	Green	Left
4	Blue	Bottom
5	White	Top
6	***no connection***	
7	Black	(switch common)
8	***no connection***	
9	Orange	Button



Joystick connector wiring and interface to PET user port.

contain the address of where the line is located in memory.

This routine can then be used to create self-modifying programs, store data within a program DATA line or delete program instructions. I hope to cover some of these fancy program tricks in future columns. They're quite easy once you've tried them.

Simple Joystick Interface for the PET

Cursor magazine is providing some of the best software for the PET, with some very fancy games currently available. Now that they are providing more programs that use joysticks, you may want to add a pair to your system to take full advantage of these new programs. *Cursor*'s programs are designed to work with all three of the dual Atari joystick adapters currently available from Coyote Electronics, Box 101, Coyote CA 95013; Creative Software, Box 4030, Mountain View CA 94040; Chuck Johnson, 17104 Via Alamitos, San Lorenzo CA 94580.

If you'd rather construct your own interface, the joysticks can be ordered directly from Atari. Sears Roebuck and Co. lists them on page 651 of their Christmas Catalog at $9.95 each (catalog #6C99835). The accompanying diagram shows a simple interface to connect two joysticks to the PET user port. The joysticks come with a 9-pin subminiature-D connector at the end of the connecting cable. Mating connectors are rather expensive and may be hard to find. You may want to cut these connectors off and wire the joysticks directly to your user port connector. The diagram shows both the connector pin number and the internal wire color for whichever scheme you choose to use.

The interface simply connects each switch to a separate input line of the user port. The joystick button is then connected to the TOP and BOTTOM switches, using two diodes to isolate the three switches. This combination provides a unique 4-bit code at the user port for each joystick position. I haven't been able to compare this interface with those commercially available, but it does work well with the *Cursor* programs.

Please address any correspondence to: Robert W. Baker, 15 Windsor Drive, Atco NJ 08004.

COMPUTER CLINIC

The Craig County Virginia Public Schools have recently placed Level II TRS-80s in pilot programs in both elementary and secondary schools. These machines are being used with computer-assisted instruction (CAI) and educational programs. Because of an apparent scarcity of CAI programs, K–12, school personnel and advanced secondary students are developing such programs. This process is slow, however, when the ultimate objective is to offer CAI in a variety of subjects at all grade levels. We would be glad to contact schools and/or individuals interested in exchanging programs they have developed.

Earl R. Savage
Craig County Public Schools
PO Box 245
New Castle VA 24127

I have a terminal of unknown origin (CRT, power supply, boards and keyboard). The only identification I can find is a label: BA Sanders Associates, Inc., Data Systems Division, Model 722-1 FI, Serial #ED0170, NFPA Type II. Does anyone out there know where I can get schematics, documentation, etc? I will reimburse postage for all replies.

Kendall Stambaugh
5009 Guide Meridan
Bellingham WA 98225

I am trying to find a battery backup for the S-100 bus. I need one already built; however, a set of plans will work as well.

Byron E. Parrish
Clipper Trading Co.
1718 Santa Fe Trail
Grand Prairie TX 75051

A friend and I are each buying PETs with factory auxiliary cassette tape storage. Over the years, we have written BASIC programs to run with our machines. The problem is that we cannot figure out how to efficiently convert our OS Partitioned Data Sets into cassette tapes to load into our PETs. Typing these programs manually from listings would be too error prone and would take forever. A friend suggested we dump the program libraries on seven- or nine-track IBM tapes. We could then shop in software houses that supplied cassettes for someone to convert our tapes to cassettes. Can anyone suggest where we can get a list of companies or people to try, if the idea is feasible, or, if it is not, suggest a technique that will work.

Mitch Nadler
4283 Bedford Ave.
Brooklyn NY 11229

I have an E & L Instruments MMD-1 microcomputer with an MMD1/1 memory board. As an exercise in digital design, I am planning to add eight 2114s and four 2708s, which I will interface with the abovementioned units. My problem is, I don't know how to go about designing the necessary decoding circuits to drive the memory ICs. Two areas on the boards are labeled "decoding." How do the people who designed the circuits come up with the particular memory decoding that is used. Is there an E & L or other publication dealing with this particular subject. If so, what do I look for?

Gerald F. Gronson
28185 Alden
Madison Heights MI 48071

CLUB NOTES

Washington DC

The Washington Amateur Computer Society is an organization dedicated to personal computing. WACS meets at 7:30 PM on the last Friday of each month in the first-floor lecture hall of Keane Hall, Catholic University of America. Contact WACS c/o 4201 Massachusetts Ave. #168, Washington DC 20016.

Danvers MA

HUG Northshore, a computer club for Heathkit computer users, meets the second Wednesday of each month (7 PM) at Hill Tech Building, 88 Holten St. (third floor), Danvers MA. The club publishes a monthly newsletter; for a free copy, write to HUG Northshore, PO Box 112, Danvers MA 01923.

Toronto Ontario

The Canadian Compucolor User's Group invites you to join the group and utilize its growing program library. For more information, contact House of Computers, Inc., 368 Eglinton Ave. West, Toronto Ontario, Canada M5N 1A2. 482-4336.

Washington DC

Washington Area KIM Enthusiasts (WAKE) meet the third Wednesday of each month, 7:30 PM, at the McGraw-Hill Continuing Education Center in DC. For a copy of the current WAKE newsletter, send an SASE to WAKE, c/o Ted Beach, 5112 Williamsburg Blvd., Arlington VA 22207. 538-2303.

Portland OR

Any Sorcerer user living in the southwest Washington and greater Portland area is welcomed to join the Portland Area Sorcerers Users Group, which plans to publish a regular newsletter and hold meetings. For further information, contact either Timothy Huang at 9529 N.E. Gertz Circle, Portland OR 97211, 289-9135 (Mondays and nights); or Gary Emmerson at 631 S.E. 41st, Apt.

43, Portland OR, 233-9684 (nights).

Akron OH

The Akron Digital Group provides tips on hardware and software applications, and plans to offer classes. The group meets the fourth Wednesday of each month, 7 PM, at the Kenmore Public Library, 2200 14th St. SW, Akron OH. For information, contact Lon Laurich, 107 7th St. NW, Barberton OH 44203. 745-7819.

Hamilton Ontario

Inquiries concerning membership in the Ontario Society for Microcomputers in Education (OSMIE) should be addressed to N. Solntseff, Unit for Computer Science, McMaster University, Hamilton Ontario, Canada L8S 4K1. OSMIE's goal is to promote the use of microcomputers in all aspects of education.

Phoenix AZ

For $4 dues per year, you can join the Arizona Computer Society, PO Box 15623, Phoenix AZ 85060. The society meets on the first Tuesday of each month at 8 PM, Rm. 209, DeVry Institute, 4702 N. 24th St., Phoenix.

Fairfield CA

The Solano TRS-80 User's Club (STUC) meets informally every third Thursday at Owens-Illinois, 2500 Huntington Drive, Fairfield CA. Anyone interested in getting STUC should contact Dave or Steve Irwin at 422-3347.

LETTERS TO THE EDITOR

Oh-Oh

For October's article winner I vote for "Hurricane," page 84. This well-written article reflects a thorough job of programming. In fact, it is the first such article written for the TRS-80 Level II that actually ran in my machine without modification . . . timely, too, although Mr. Segar could hardly have foreseen "Fred" at the time he wrote and submitted the article for publication.

I have one suggestion, which you might like to pass on to your authors. Some of us who have been around for seventy, eighty or more years don't see fine details as we once did (I noticed it particularly at the beach this summer), and that fine print you use for the program listings is difficult for us at best. It's like this.

The letter O and the figure 0 have been in use for quite a spell, but even though I had three years of schooling, until I started playing around with computers I never realized that a zero was really nothing but a hungry O.

So, can you suggest that your contributors avoid the use of the letter O for variables? Maybe a D or a Q? These latter could still provide debugging experience, but it wouldn't be as boring.

A. R. Taylor
Gravette AR

I have received numerous letters regarding my "Hurricane" article and have been pleased regarding the "worked the first time" comments. The "Hurricane" program listing you published is correct; however, I did learn one valuable secret, which I suggest you pass on to your future authors. Never use the letter O as a variable, especially when using BASIC shorthand in a program. When printed without the slash, it is difficult, unless you look closely, to tell the difference between the letter O and zero. One reader misinterpreted the zeros in lines 200 and 201 for variable Os. In doing so he completely changed the statement. I also left out the THEN portion of the IF/THEN statement. This is allowable in Radio Shack Level II BASIC shorthand and probably also led to his confusion. Lines 200 and 201 are easier to understand if written as follows:

```
200 IF L>0 THEN R=1
201 IF L<0 THEN R=0
```

Without these lines, the program definitely won't work in all quadrants of the globe.

I discovered one other interesting "quirk," which I will pass on. Although they look much alike, the constant 1.5708 used in lines 310, 350 and 410 is not the same as the constant 1.15708 used in line 470. 1.5708 is used in the radian/degree conversion, while 1.15708 is used to convert nautical miles to statute miles.

Bryce D. Segar
Ft. Douglas UT

Scientific Applications

We hear more and more about the business revolution caused by the microcomputer. Magazines such as *Microcomputing* are full of articles on business applications and advertisements for business-oriented systems. Indeed, if we lightly read these publications we may get the impression that there are only three types of microcomputer users: 1. the hobbyist (a dying breed), who sits in the garage and plays with integrated circuits, but never really *does* anything with his machine; 2. the "home computer user," who uses his computer as a glorified video game, but has difficulty justifying it to his wife or the neighbors; 3. the business user, who uses the machine in his business, but who has trouble getting support from the manufacturers.

It sometimes seems that manufacturers and publishers are looking forward to that great day in the future when every mom-and-pop-type drugstore will have a computer in the back taking care of sales, billing, inventory, payroll and taxes. Since there are so many small businesses in the country, let's make all the computers to satisfy them, and just ignore all the other users. They're only hobbyists or educators (neither of whom have any money), so they don't matter.

I believe that the microcomputer manufacturers are overlooking scientific applications. Scientists and engineers are already among the larger users of mainframes in the U.S. today. A look at the equipment manufacturers' ads in *Physics Today* will show that about a third of the equipment manufactured is something that contains a dedicated microprocessor. And scientists have money to spend on equipment, too.

Scientific computers ordinarily perform three functions (two of them not dissimilar to functions performed by "business" computers): analysis of data and storage of information. We can use text editing, too. The only real point of difference between "scientific" computers and "business" computers is that scientists like to use the machine for direct data acquisition.

To my knowledge, the only mainframe manufacturer seriously addressing the problem of the scientific user is Digital Equipment Corporation. My own microcomputer is an SWTP 6800 with 24K of memory, dot matrix printer, Kansas City Standard cassette interface and drive, 5 1/4" disk driver with DOS, plotter, 256×256 graphics and an 8-channel, 8-bit ADC with a 50 microsecond conversion time. I have half again the memory and can load programs from cassette three times as fast.

All this is the result of a cash outlay of about $3000. If I were to include the cost of my time for construction of the graphics interface and all of the programming I had to do, it would probably raise that to about $7000. But most of what I had to do was reinvent several wheels.

Dr. Gordon W. Wolfe
Asst. Prof., Physics/Astronomy
University of Mississippi

Epistolary Correspondence on Polysyllabification

Well, I just read Mits Hadeishi's letter (November 1979), and I was moved to write.

He's right! What kind of a title is "Microcomputing"? A lot of people can't even *pronounce* it! What's so bad about 1000 bits per second? People didn't understand

it? So why change to something *more* egregious?

73 has a good name. It's related to ham radio; it's *short* and easy to remember. Now we can do the same thing here without changing the name much—just call the magazine "Kilo." Remember: Ease of recognition of a name varies inversely with the number of syllables.

I don't care for the business-boxy cover photos. They look like U.S. Army tech manuals. How about pictures of kids with color graphics displays? Computer graphics displays? Something eye-catching? I think it looks better not to have the table of contents on the front; you have too many articles for something that important. However, the cover picture could be related to one of the articles inside. I think it's a good idea to have a thematic issue *now and then*, but not very often.

Please bring back *Kilobaud*. It's hard to advertise your mag (which is still the best) by word of mouth when the title is mike-ko-to-te-pring, or something like that.

Richard A. Rodman
Vienna VA

Still More

Try the circuit in Fig. 1 with David Morr's TTY program (August 1979 issue, p. 38).

John C. Rogers, Jr.
New Bedford MA

Ink Up and Start Typing

The article on the Centronics 779 Printer in the October 1979 issue was interesting and well written. I have had a Centronics 780 printer for a little more than one year now, and I have a tip I would like to pass along. My 780 has the same ribbon assembly as the Model 779. The only problem I have ever had with the ribbon is the short lifetime of the ink within it. Ribbons are too expensive to replace very often, so I came up with a better solution.

For less than one dollar I bought a bottle of ink for re-inking pads. Now when my ribbon runs low on ink I simply apply some more ink to the top edge of the ribbon. I'm careful not to soak the ribbon too much.

I continue printing until the ribbon has made a complete pass through the ribbon cartridge, and then apply a little more ink to the top of the ribbon since what was on bottom is now on top. The pinch rollers help distribute the ink along the length of the ribbon so that by the third pass, it is like a new ribbon.

I have been using this method on the same ribbon for about ten months, and it currently shows no sign of wear, though I do not expect it to last forever.

By the way, does anyone else out there have an F-8 microprocessor system? Mine is called a Termdisk (it contains an eight inch floppy disk) and is manufactured by International Computer Products in Dallas. It is a capable system even though it runs on an F-8. Anyone interested in F-8s, let me know. I doubt *Microcomputing* will ever print any articles on them.

Gary Fancher
204 Dee Lane
Arlington TX

Before we can print any F-8 articles, someone must write them. How about you, Gary?—Editors.

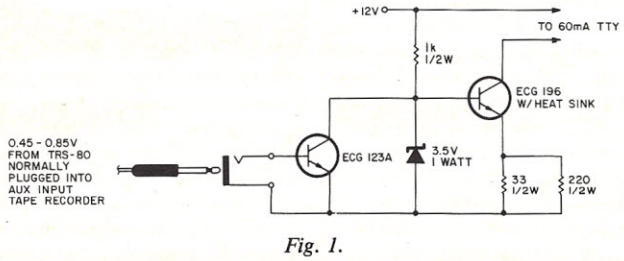


Fig. 1.

Editor, KILOBAUD Microcomputing
Pine Street
Peterborough, NH 03458

Dear Sir:

I like

kilobaud
Microcomputing

I also thought that having the complete table of contents on the front cover was a fine idea.

You do a great job between the covers.

Sincerely,

Lloyd L. Foster, Jr.
Instructor
Electronics Engineering Technology

Gobble, Gobble, Gobble

Murphy was an optimist.

Else, why would a typo creep into Bill Harvey's October 1979 article, page 99, second column, third paragraph, where he is talking about his system. The typesetter, not believing his eyes, inserted an n, erroneously producing the word "turnkey." This is obviously an error since the next word is "home-built."

Surely, everyone except the typesetter knows that a turnkey system is one bought complete with all software and hardware, in one package, usually for one price, and most often for one particular application, ready to plug in and start processing data. The term probably stems from an analogy to an automobile purchase where you pay your money, turn the key and drive away.

If the application is BASIC programming, then some turnkey systems are the PET, the TRS-80, the Sorcerer and TI 99/4. But there's no way a "home-built" system can be a turnkey system. Obviously Mr. Harvey intended it to read as follows: "turkey home-built system."

Now, don't you understand? Murphy was an optimist!

D. A. Bishop
Austin TX

Both the editor who worked on the article, and the typesetter who set it, are former prison guards (who often had to restrain compulsive crank-letter writers from going berserk in the exercise yard and trying to hoe messages to the warden in the turf). Consequently, our editor and typesetter are still imbued with prison parlance and undoubtedly had their previous jobs in mind when they edited and set the article.—Editors.

Port Alright

As you know, one of the greatest obstacles to using a microcomputer in a business application is the lack of qualified hardware repair specialists and software consultants. I own a Sol with a Helios IV disk drive and have tried to obtain satisfactory service in the Houston area for several months—all to no avail. The local PTC dealer (at least until PTC's recent demise) proved to be totally incompetent and unprofessional.

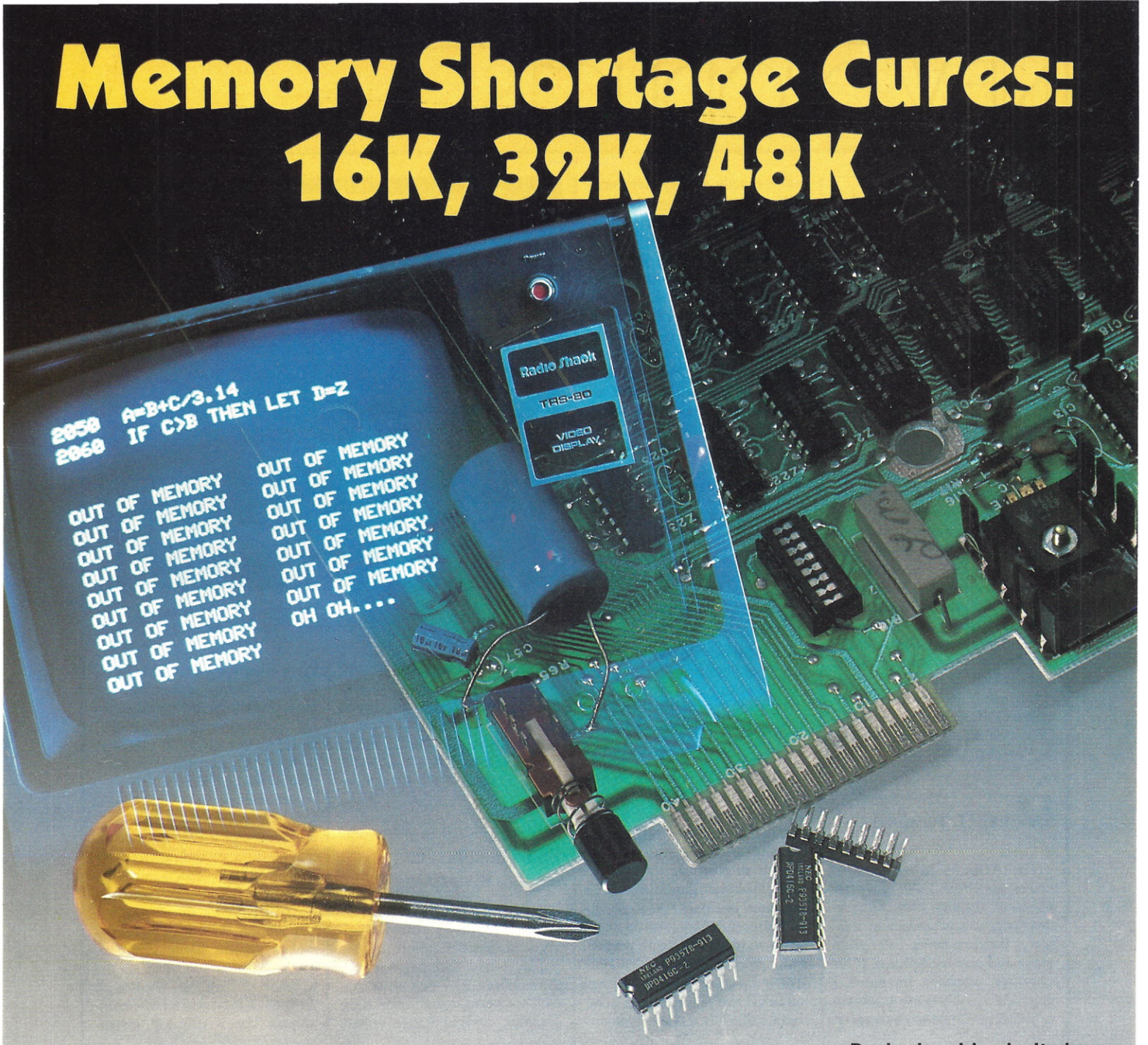
A few weeks ago I noticed in your magazine an advertisement for Computer Port in Arlington TX offering software for the Sol. On a lark, I called them to find out more, and as with all good stories, there was a happy ending.

I was invited to their offices to have my system repaired (it had been down for 16 weeks at the local dealer) and to consult with them on my specific software problems. In two days my entire system was not only repaired, but upgraded as well. Their service department was remarkable in that they were able to perform repairs on both drives, which, according to all information available in Houston, required service in California.

I just though you might like to know that there are some good people around who support the efforts and standards of your magazine, and who can perform the same.

Kenneth J. Edwards III
Houston TX

Memory Shortage Cures: 16K, 32K, 48K



Dealer Inquiries Invited

The Product. Only high quality, prime, burned-in and tested 4116 16K dynamic RAMs. Don't be caught unaware! All TRS-80 memory expansion kits are not the same. UHF Associates' memory expansion gives you high quality coupled with outstanding performance. And with their fast 200 NS minimum access time (less CPU wait states) UHF's 4116 16K dynamic RAMs provide both storage and speed that won't disappoint you later down the road.

The Price. 16K Memory Expansion Kit for either computer (pre-programmed DIP shunts included) or expansion interface, $95. More? 32K Kit for expansion interface, $180. Most? 48K Kit for computer and expansion interface, $265.

The Promise. "Thou shalt not wait, worry or fret." You'll get immediate post-paid delivery from in-stock inventory. You'll get a full 12 month warranty. That's about four times the warranty others offer. And for installation, you'll get UHF's "goof-proof" instructions. All you'll need is a screwdriver and about 10 minutes.

TRS-80 is a registered trade mark of Tandy Corporation.

☐ **16K Kit with shunts** (for computer)	$ 95
☐ **16K Kit** (for expansion interface)	$ 95
☐ **32K Kit** (for expansion interface)	$180
☐ **48K Kit** (for computer and expansion interface)	$265

California residents please add appropriate sales tax

Name (print) _____

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City _____ State _____ Zip _____

☐ I've enclosed a check or money order for $ _____ payable to **UHF Associates.**

We honor: ☐ Master Charge ☐ VISA/BankAmericard

Account # _____

Expiration Date _____

Signature _____

(required for charge card purchases)

U14

UHF ASSOCIATES

90 Transport Avenue, #4
Rohnert Park, CA 94928
Call 707/584-7844

NEW PRODUCTS

Edited by Dennis Brisson

Video Display Terminal

The InterTube II Video Display Terminal has recently been upgraded with the addition of a new version of software—version 1.7—which enables several new user-oriented editing features such as erase-to-end-of-line and page. Standard features of the InterTube include an upper and lowercase character set on an 8 × 10 dot matrix, a full 24 line by 80 character screen; a status line that displays the operating mode of the terminal and a complete ASCII typewriter-style keyboard with an 18 key numeric pad. The terminal includes a hooded display to cut down on glare and give extra privacy. A wide bandwidth monitor provides sharp images everywhere on the screen with below-the-line character descenders to make reading easier. Price is $995.

Intertec Data Systems Corporation, 2300 Broad River Road, Columbia SC 29210. Reader Service number I21.

Smart CRT Terminal

The ADM-31 smart terminal offers two full 1920 character pages of display with independent page characteristics of Protect, Write/protect, Program mode and cursor retention. If the operator changes to another page, the attributes are automatically stored in memory and are recalled exactly as they were originally when the page is readdressed. The microprocessor-based ADM-31 is completely self-contained and comes equipped with keyboard, control logic, character generator, refresh memory and interface. The terminal's keyboard is integrated with main logic and can generate a full 128 ASCII character set. A numeric keypad is also included.

Full editing capabilities allow the user to clear the screen, use a destructive cursor for character change, skip protected fields, backspace, move up, down, return, home and new line. The ADM-31 features a high-resolution, 12-inch diagonal display screen with 24 lines of 80 characters in a 7 × 9 dot matrix. Price is $1450.

Lear Siegler, Inc./Data Products Division, 714 N. Brookhurst, Anaheim CA 92803. Reader Service number S127.

32K RAM for the H8

The DG-32D is a 32K RAM board for Heath H8 computers. Designed to operate either with or without the present static memory in the computer, the DG-32D is ready to plug into the H8 and use without additional wiring. It consumes less than 6 Watts power. Features include: full compatibility with current Heath peripherals, circuit protection to prevent damage to memory output buffers if two blocks are assigned to the same address space, memory addressing controlled by DIP switch and transparent refresh. Price is $479, assembled, tested and burned-in.

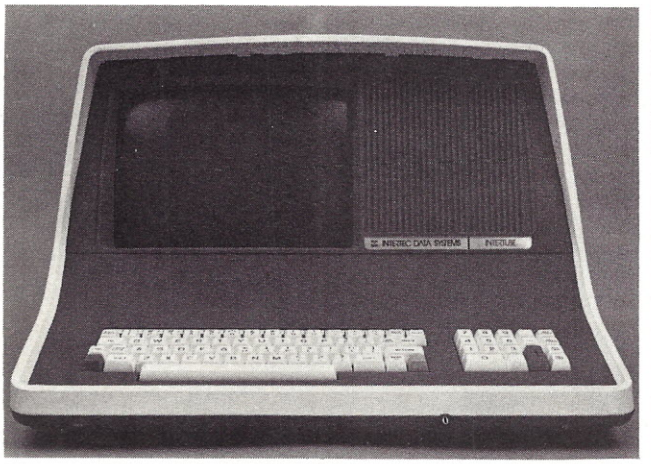
D-G Electronic Developments Co., PO Box 1124, Denison TX 75020. Reader Service number D70.

The ADM-31.

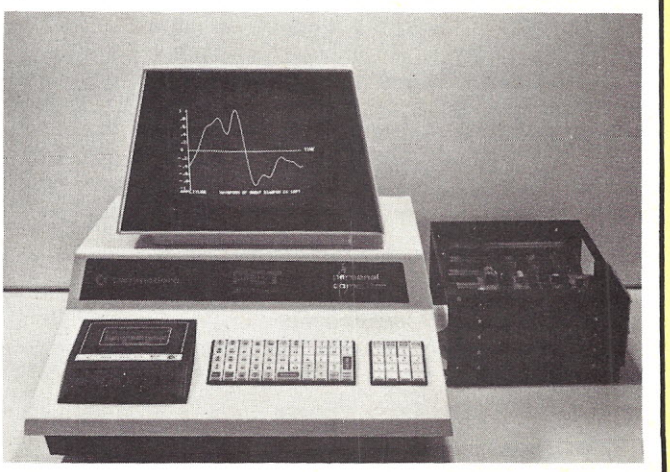
PET Graphic Display Board

The K-1008A-P Visible Memory is a high-resolution graphic display board that upgrades the Commodore PET computer system to permit high-resolution graphics. During image update there is no snow or visible interference. When not used for graphics, the board serves as an 8K byte expansion memory, doubling the 8K PET capacity. K-1008-3C graphic software ($20) is also offered.

The display board puts up a high-resolution matrix of 64,000 dots (320 wide × 200 high) and allows control of the on/off state of each dot individually and independently. The board interfaces to the PET with the K-1007A-1 bus adapter ($99) with easily detached ribbon cable interconnects. Without bus adapter, the K-1008A-P can be used with AIM-65, KIM-1 and SYM-1 computers. The K-1005A-P expan-



The InterTube II.



Upgrading the PET with the K-1008A-P.

sion card file ($80) is optional. Price is $243.

Micro Technology Unlimited, PO Box 4596, Manchester NH 03108. Reader Service number M44.

Apple II Joystick

The PAIA/Apple II Joystick Controller features plug-in compatibility with Apple II's game I/O connectors, precision-gimbaled self-centering action and case style and color consistent with the Apple II. Other features include front-panel trimmers for x- and y-axis outputs and a capacitively activated closure to the Apple II's SW0 input which operates with a finger's touch of the controller's metal shaft. Closure to Apple II's SW1 input is activated with a standard push button. Price is $65.

PAIA Electronics, Inc., 1020 Wilshire Blvd., Oklahoma City OK 73116. Reader Service number P9.

Double-Density Floppy Disk Interface

The Tarbell Double-Density Floppy Disk Interface enhances existing disk storage capacities with only minimum reconfiguration of existing microcomputer systems. The interface board is supplied with the new BASIC Input/Output System (BIOS) software for CP/M on single-density diskette, permitting the user to intermix single- and double-density diskettes. The Tarbell system automatically determines whether single or double density is in use. As many as four drives, using either single or double density, can be selected.

The 8 inch Shugart-compatible disk interface contains phase-lock loop and write precompensation, providing more reliable data storage and recovery. The on-board phantom bootstrap PROM is disabled on completion of the bootstrap operation, freeing all 64K of memory address space for other use. Multi-user operation is now possible. Extended addressing capability provides eight additional address bits, allowing direct transfers to and from any location within a 16 megabyte address range. Price is $425.

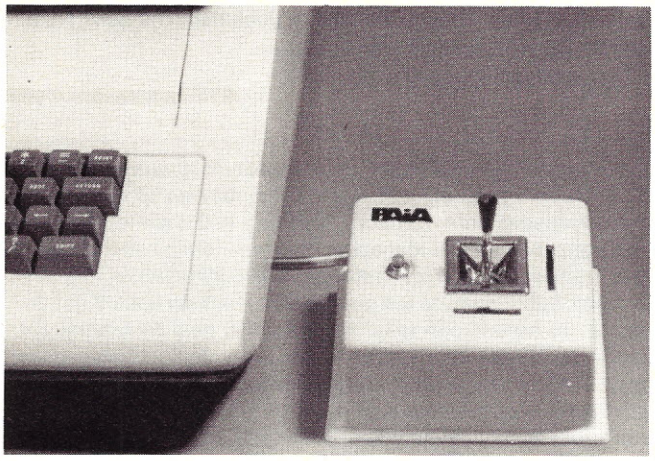
Tarbell Electronics, 950 Dovlen Place, Suite B, Carson CA 90746. Reader Service number T11.

S-100 6809 CPU Card

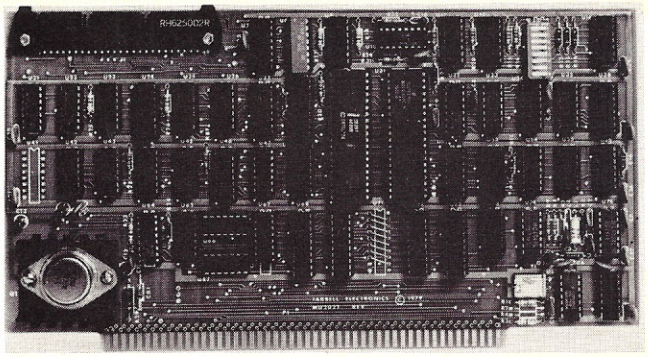
The MD-690b CPU card brings the 6809 processor to the S-100 bus. This single-board computer integrates I/O, RAM, PROM cassette interface and other features in a complete package for instant use. With the MD-690b you have your choice of two different monitor PROMs. MON-BUG II provides the firmware you need to interface to memory-mapped video cards such as the VB1-B and MicroDaSys' full-color, 80 × 24 ColorMaster video card. RSBUG II enables the user to interface directly to an RS-232 terminal using the board's own hardware.

Features include an on-card 2400 baud (Manchester encoded)/300 baud (KC Standard) cassette interface, 1K static RAM, 10K PROM space, RS-232 level shifters, an interrupt-driven keyboard input, 20 I/O lines, power-on reset, DMA capability, interrupt handling and real-time clock. Prices are $239 (kit) and $299 (assembled and tested).

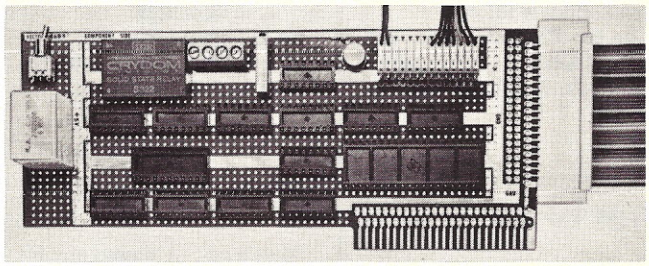
MicroDaSys, PO Box 36051, Los Angeles CA 90036. Reader Service number M110.



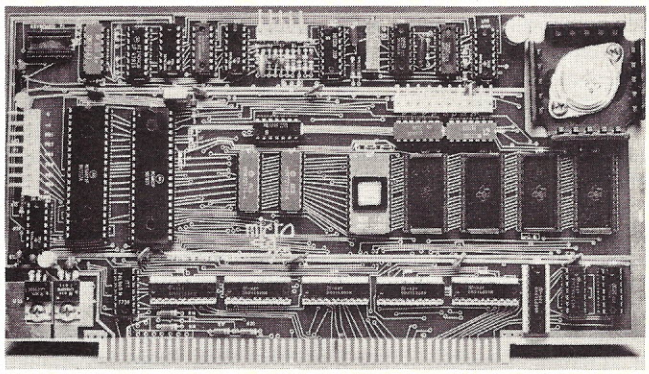
PAIA's joystick for Apple II.



Tarbell's double-density floppy disk interface.



Model 4609.

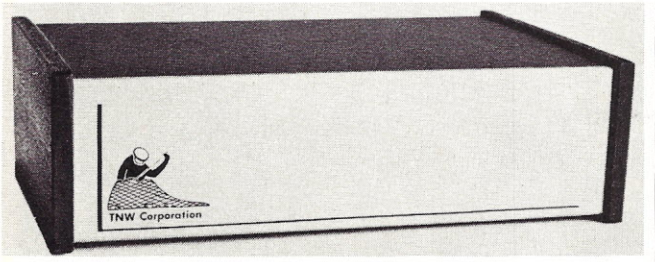


The MD-690b CPU card.

Interface Board for Apple and PET

The Model 4609 is a new peripheral interface board that is compatible with Apple II and Superkim microcomputers without any special adapter unit, as well as with the PET Commodore unit, provided an adapter unit called Expandamem has been installed in it. The board has provisions for extended board area and dual heavy-duty power buses between the DIP IC leads for easy, short bus connections. The 4609 is designed for construction of special control, communications, peripheral or memory interface circuits using support devices by major semiconductor manufacturers, as well as for breadboarding experimental circuits.

Three connectors, in addition to the standard 25/50 system bus, are available for input/output. A 20/40-contact card-edge connector, fabricated on the rear of the board, mates with a 3-M-type ribbon connector. Alternatively, a right-angle solder-tail header may be positioned in this same location. The Model 4609 also ac-



The TNW-2000.

commodates the miniature SIP-type connectors, which may be placed on the periphery or in mid-board. Price is $21.50.

Vector Electronic Co., Inc., 12460 Gladstone Ave., Sylmar CA 91342. Reader Service number V8.

Serial Interface

Now you can interface your computer to standard RS-232 printers, terminals, modems and other computers with the TNW-2000 Serial Interface, which adds a bidirectional RS-232 port to the Commodore PET and other IEEE-488 computers.

You can set the baud rate from 110 to 9600 bits per second and switch-select the IEEE bus address, data word length/parity (8-bit words without parity or 7-bit words with even or odd parity) and operation with either 115 V or 230 V 50/60 Hz power sources (power supplies are built in). Enabling automatic conversion between the (old style) PET and ASCII character sets for both input and output is also possible.

Other devices can be used on the IEEE bus with the TNW-2000. A 1 meter IEEE bus cable provides a daisy-chaining capability with both the PET-style edge-board connector and the IEEE-488 standard ribbon connector. Price is $229.

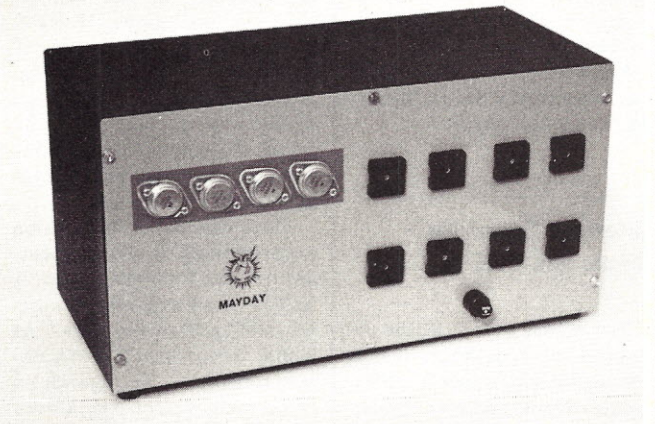
TNW Corporation, 3351 Hancock Street, San Diego CA 92110. Reader Service number T56.

TRS-80 Power Supply

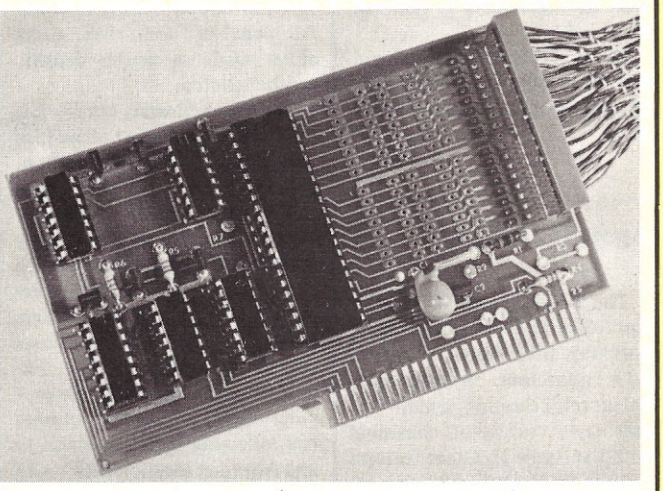
Mayday is an uninterruptible power supply that keeps your computer on—and thus saves your program and data from being lost—when the power fails. It provides instant power switch-over when a power outage occurs and protects from any ac line surges due to neighboring large current changes. Especially designed for the TRS-80, Mayday can handle the complete business system of video, expansion interface, CPU and four disk drives for about one-half hour of power outage; nonbusiness systems will hold for about one hour. It will also handle other microcomputers that have about 140 Watts power consumption; 250 Watt capability is also available.

Mayday maintains charge on the standby battery during normal usage and is always ready for use, no matter when the line voltage fails. Accessories include a battery and line surge protector.

Sun-Technology, Inc., Box 210, New Durham NH 03855. Reader Service number S126.



Mayday.



The AI-02.

Apple Analog Input Card

The AI-02 Analog Input Card provides a single-card data acquisition system for Apple II computers. Sixteen analog channels may be monitored by the system with 8-bit resolution. Channels are individually addressable, and conversion time is 70 microseconds. The system can be operated from BASIC and also provides interrupt capability for more efficient software implementation. The AI-02 is suited to such applications as temperature sensing and process control.

Interactive Structures, Inc., Suite 204, 3401 Science Center, Philadelphia PA 19104. Reader Service number I49.

Also, see pages 188 and 189 for new software releases.

CONTEST!

Winner of the "best article of the month" for October is Allan J. Domuret, author of "Expanded TRS-80 Operations."

Winner of a lifetime subscription to *Microcomputing* is C. A. Lopez of El Paso, Texas. Choice of a book from the Book Nook goes to Saul G. Levy of Tucson, Arizona.

Congratulations to everyone.

One of your responsibilites, as a reader of *Kilobaud MICROCOMPUTING*, is to aid and abet the increasing of circulation and advertising, both of which will bring you the same benefit: a larger and even better magazine. You can help by encouraging your friends to subscribe to *Kilobaud MICROCOMPUTING*. Remember: Subscriptions are guaranteed—money back if not delighted, so no one can lose. You can also help by tearing out one of the cards just inside the back cover and circling replies you'd like to see: catalogs, spec sheets, etc. Advertisers put a lot of trust in reader requests for information. To make it more worth your while to send in the card, a drawing will be held each month and the winner will get a lifetime subscription to *Kilobaud MICROCOMPUTING*!

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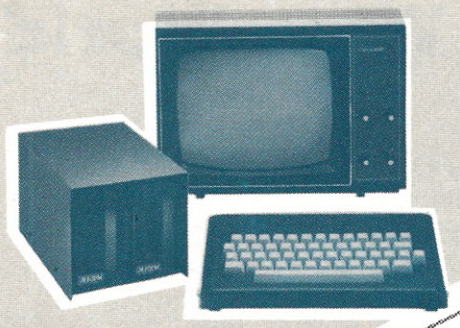

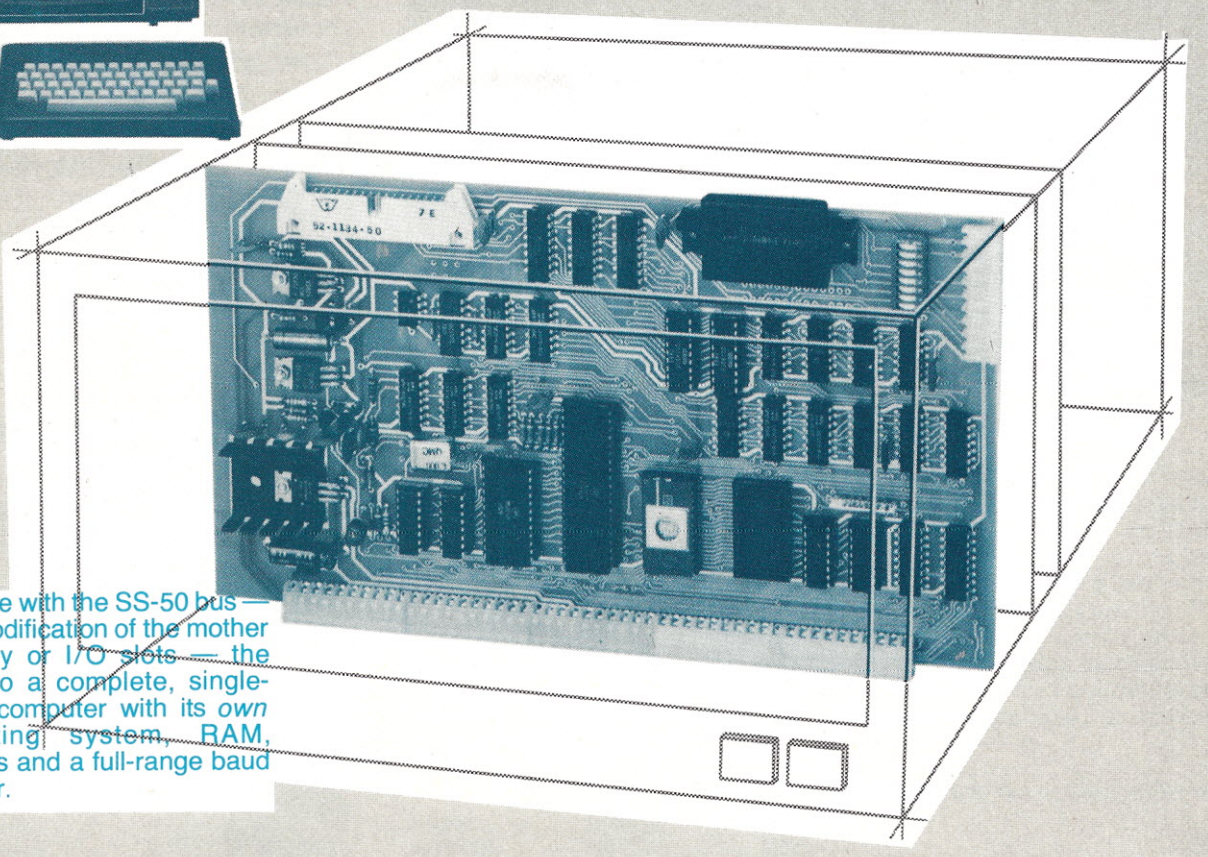

Fully compatible with the SS-50 bus — requiring *no* modification of the mother board, memory or I/O slots — the SBC/9™ is also a complete, single-board control computer with its *own* ROM operating system, RAM, peripheral ports and a full-range baud clock generator.

Make the SBC/9™ the heart of your computer and put to work the most outstanding microprocessor available, the 6809.

the Mighty 6809

Featuring more addressing modes than any other eight-bit processor, position-independent coding, special 16-bit instructions, efficient argument-passing calls, autoincrement/autodecrement and more, it's no wonder the 6809 has been called the "programmers dream machine."

Moreover, with the 6809 you get a microprocessor whose programs typically use only one-half to two-thirds as much RAM space as required for 6800 systems, and run faster besides.

And to complement the extraordinary 6809, the Percom design team has developed PSYMON™, an extraordinary 6809 operating system for the SBC/9™.

PSYMON™ — Percom SYstem MONitor

Although PSYMON™ includes a full complement of operating system commands and 15 externally callable utilities, what really sets PSYMON™ apart is its easy hardware adaptability and command extensibility.

For hardware interfacing, you merely use simple, specific device driver routines that reference a table of parameters called a Device Control Block (DCB). Using this technique, interfacing routines are independent of the operating system.

The basic PSYMON™ command repertoire may be readily enhanced or modified. When PSYMON™ first receives system control, it initializes its RAM area, configures its console and then 'looks ahead' for an optional second ROM which you install in a socket provided on the SBC/9™ card. This ROM contains your own routines that may alter PSYMON™ pointers and either subtly or radically modify the PSYMON™ command set. If a second ROM is not installed, control returns immediately to PSYMON™

- Provision for multi-address, 8-bit bidirectional parallel I/O data lines for interfacing to devices such as an encoded keyboard.
- A serial interface Reader Control output for a cassette, tape punch/reader or similar device.
- An intelligent data bus: multi-level data bus decoding that allows multiprocessing and bus multiplexing of other bus masters.
- Extended address line capability — accommodating up to 16 megabytes of memory — that does not disable the on-board baud rate clock or require additional hardware in I/O slots.
- On-board devices which are fully decoded so that off-card devices may use adjoining memory space.
- Fully buffered address, control and data lines.

The SBC/9™, complete with PSYMON™ in ROM, 1K of RAM and a comprehensive users manual™ costs just $199.95.

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P82

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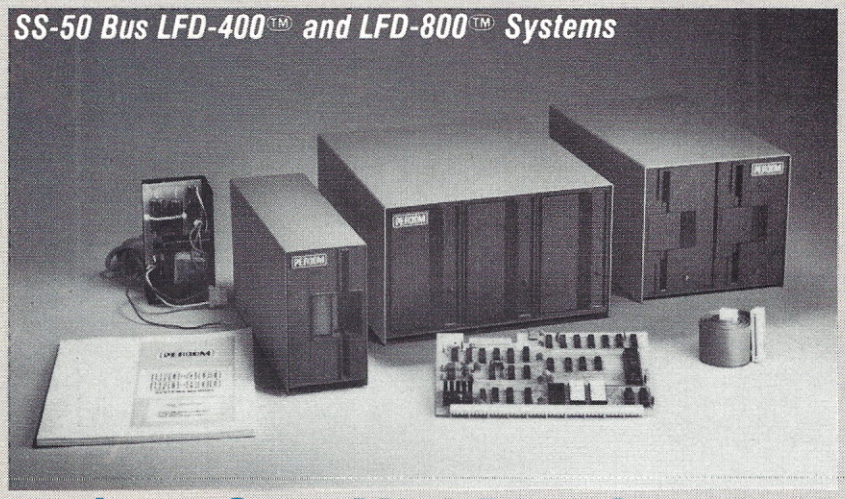
Welcome to Percom's Wide World



SS-50 Bus LFD-400™ and LFD-800™ Systems

Each LFD mini-disk storage system includes:

- drives with integral power supplies in an enamel-finished enclosure
- a controller/interface with ROM operating system plus extra ROM capacity
- an interconnecting cable
- a comprehensive 80-page users manual

P67

Low-Cost Mini-Disk Storage in the Size You Want.

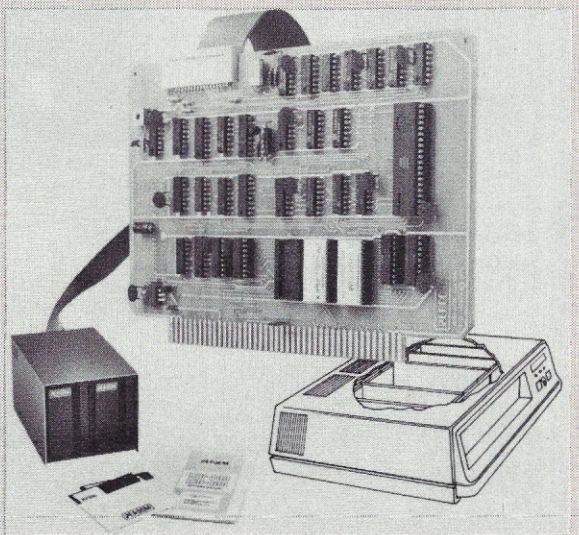
Percom LFD mini-disk drive systems are supplied complete and ready to plug in the moment they arrive. You don't even have to buy extra memory. Moreover, software support ranges from assembly language program development aids to high-speed disk operating systems and business application programs.

The LFD-400™ and -400EX™ systems and the LFD-800™ and -800EX™ systems are available in 1-, 2- and 3-drive configurations. The -400, -400EX drives store 102K bytes of formatted data on 40-track disks, and data may be stored on either surface of a disk. The -800, -800EX drives store 200K bytes of formatted data on 77-track disks.

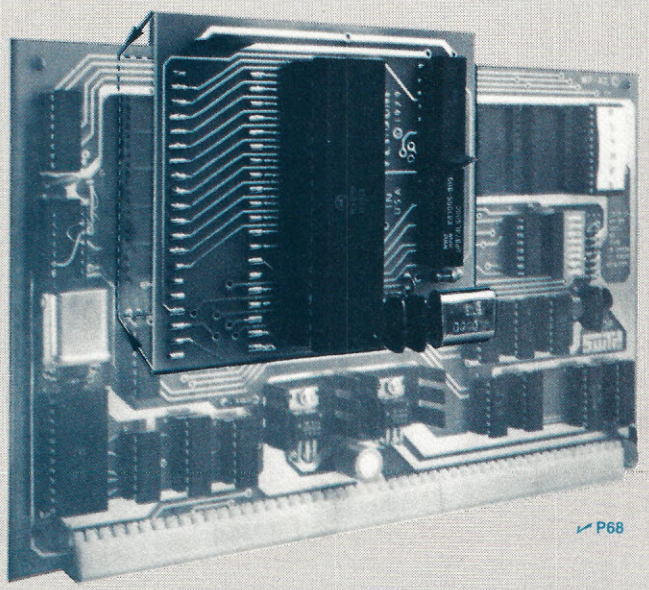
The LFD-1000™ systems (not pictured) have dual-drive units which store 800K bytes on-line. The LFD-1000™ controller accommodates two drive systems so that a user may have as much as 1.6M bytes on-line.

Mini-disk storage system prices:

MODEL	1-DRIVE SYSTEM	2-DRIVE SYSTEM	3-DRIVE SYSTEM
For the SS-50 Bus:			
LFD-400™	$ 599.95	$ 999.95	$1399.95
LFD-800™	895.95	1549.95	2195.95
For the EXORciser* Bus:			
LFD-400EX™	$ 649.95	$1049.95	$1449.95
LFD-800EX™	945.95	1599.95	2245.95
LFD-1000™	(dual) $2495.00	(quad) $4950.00	—



EXORciser* Bus LFD-400EX™, -800EX™ Systems



P68

Upgrade to 6809 Computing Power. Only $69.95

Although designed with the SWTP 6800 owner in mind, this upgrade adapter may also be used with most other 6800 and 6802 MPUs. The adapter is supplied assembled and tested, and includes the 6809 IC, a crystal, other essential components and user instructions. Restore your original system by merely unplugging the adapter and a wire-jumpered DIP header, and re-inserting the original components. Also available for your upgraded system is PSYMON™ (Percom SYstem MONitor), the operating system for the Percom 6809 single-board computer. PSYMON™ on 2716 ROM costs only $69.95. On diskette (source and object files), only $29.95.

Data Terminal & Two-Cassette Interface — the CIS-30+

P69

- Interface to data terminal and two cassette recorders with a unit only 1/10 the size of SWTP's AC-30.
- Select 30, 60 or 120 bytes per second cassette interfacing; 300, 600 or 1200 baud data terminal interfacing.
- Optional mod kits make CIS-30+ work with any microcomputer. (For MITS 680b, ask for Tech Memo TM-CIS-30+-09.)
- KC Standard/Bi-Phase-M (double frequency) cassette data encoding. Dependable self-clocking operation.
- Ordinary functions may be accomplished with 6800 Mikbug* monitor

Prices: Kit, $79.95; Assembled, $99.95. Prices include a comprehensive instruction manual. Also available: Test Cassette, Remote Control Kit (for program control of recorders), IC Socket Kit, MITS 680b mod documentation and Universal Adapter Kit (converts CIS-30+ for use with any computer).

of 6800 Microcomputing.

6800/6809 SOFTWARE

System Software

6800 Symbolic Assembler — Specify assembly options at time of assembly with this symbolic assembler. Source listing on diskette $29.95

Super BASIC — a 12K extended random access disk BASIC for the 6800 and 6809. Supports 44 commands and 31 functions. Interprets programs written in both SWTP 8K BASIC (versions 2.0, 2.2 & 2.3) and Super BASIC. Features: 9-digit BCD arithmetic, Print Using and Linput commands, and much more. Price $49.95

TOUCHUP™ — Modifies TSC's Text Editor and Text Processor for Percom mini-disk drive operation. Supplied on diskette complete with source listing $17.95

Operating Systems

INDEX™ — This easy-to-use disk-operating and file management system for 6800 microcomputers is fast. I/O devices are serviced by interrupt request. INDEX™ accesses peripherals the same as disk files — new devices may be added without changing the operating system. Other features: unlimited number of DOS commands may be added • over 60 system entry points • display only those files at or above user-specified file activity level • versions available for SWTP MF-68, Smoke's BFD-68 and Motorola's EXORciser*. Price $99.95

MINIDOS-PLUSX™ — An extension of the original MINIDOS™ for LFD-400™ mini-disk systems, MINIDOS-PLUSX™ manipulates files by six-character names. Supports up to 31 files. Resident commands include Initialize, Save, Allocate, Load, Files (directory list), Rename and Delete. Supplied on 2708 ROM with a minidiskette that includes transient utilities such as Copy, Backup, Create, Pack and Print Directory. Price . . . . . $34.95.

PSYMON™ — Percom SYstem MONitor for the Percom single-board/SS-50-bus-compatible 6809 computer accommodates user's application programs with any mix of peripherals **without** modifying programs. PSYMON™ also features character echoing to devices other than the communicating device, sophisticated register and memory dump routines and more. Price (on 2716 ROM) . . . . . $69.95.

WINDEX™ — Described in detail elsewhere on this page.

Business Programs

General Ledger — For 6800/6809 computers using Percom LFD mini-disk storage systems. Requires little or no knowledge of bookkeeping because the operator is prompted with non-technical questions during data entry. General Ledger updates account balances immediately — in real time, and will print financial statements immediately after journal entries. User selects and assigns own account numbers; tailors financial statements to firm's particular needs. Provides audit trail. Runs under Percom Super BASIC. Requires 24K bytes of RAM. Supplied on minidiskette with a comprehensive users manual. Price . . . . . $199.95.

FINDER™ — This general purpose data base manager is written in Percom Super BASIC. Works wth 6800/6809 computers using Percom LFD-400™ mini-disk drive storage systems. FINDER™ allows user to define and access records using his own terminology — customize file structures to specific needs. Basic commands are New, Change, Delete, Find and Pack. Add up to three user-defined commands. FINDER plus Super BASIC require 24K bytes of RAM. Supplied on minidiskette with a users manual. Price $99.95

Mailing List Processor — Powerful search, sort, create and update capability plus ability to store 700 addresses per minidiskette make this list processor efficient and easy to use. Runs under Percom Super BASIC. Requires 24K bytes of RAM. Supplied on minidiskette with a users manual. Price $99.95.

From the Software Works

Development and debugging programs for 6800 µCs on diskette:

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Cross Reference utility . . . . . $ 14.97

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And 'looking into' is just what you do with the Electric Window™ as you peer right into memory space where characters are being input and manipulated. Display is memory-resident, programmable and generates up to 24 80-character lines.

Other features include:

- standard character generator plus provision for optional special character generator
- dual intensity, high-lighting alphanumeric display
- scrolling by a programmable register • programmable display positioning
- programmable interlaced or non-interlaced scan
- descenders on lower case letters • users manual with application instructions and listing of WINDEX™ driver.

The Electric Window.™ Worth Looking Into. $249.95

WINDEX™ is a fast video display driver program for the Electric Window™. WINDEX™ also features: program and keyboard control of character generators • displayable control characters — under program control • automatic scrolling • a driver routine for the parallel input keyboard feature of the Percom 6809 Single-Board Computer, the SBC/9™ • auto-linking to PSYMON™, the ROM operating system for the SBC/9™ • Prices: ROM version: $39.95; LFD-400™ compatible diskette (source and object files): $29.95. P71

Now Available! the SBC/9™ MPU/Control Computer

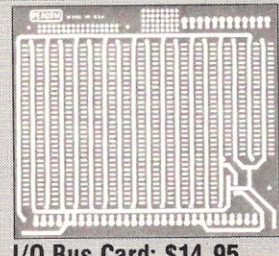
(Single-Board-Computer/6809) — stands alone as a control computer, but also compatible with the SS-50 bus for use as an MPU card. Includes PSYMON™ (Percom SYstem MONitor) in a 1K ROM and provides for additional 1K of ROM. Also includes 1K of RAM. Features: Super Port — provision for multi-address, 8-bit bidirectional data lines • an intelligent data bus for multi-level data bus decoding • an on-board 110-baud to 19.2 kbaud clock generator • extended address capability — to 16 megabytes — without disabling baud clock or adding hardware. And much more. Supplied with PSYMON™ and comprehensive users manual. Price . . . . . $199.95.

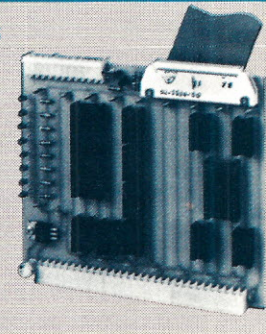
P82

See full page ad elsewhere in this magazine for all of the SBC/9™ features.

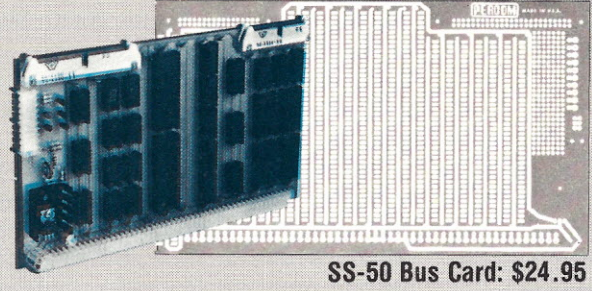
Full Feature Prototyping PC Boards

All of the features needed for rapid, straightforward circuit prototyping. Use 14-, 16-, 24- and 40-pin DIP sockets • SS-50 bus card accommodates 34- and 50-pin ribbon connectors on top edge, 10-pin Molex connector on side edge • I/O card accommodates 34-pin ribbon connector and 12-pin Molex on top edge





I/O Bus Card: $14.95



SS-50 Bus Card: $24.95

- I/O card is 1-¼ inches higher than SWTP I/O card • interdigitated power conductors • contacts for power regulators and distributed capacitance bypassing • use wire wrap, wiring pencil or solder wiring • tin-lead plating over 2-oz copper conductors wets quickly, solders easily • FR4-G10 epoxy-glass substrate.

P73

To place an order or request additional literature call toll-free 1-800-527-1592. For technical information call (214) 272-3421. Orders may be paid by check, money order, COD or charged to a VISA or Master Charge account. Texas residents must add 5% sales tax.

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Dial-up Directory

Computer bulletin board services are everywhere. To join the fun of instant information exchange, you'll need a terminal, a telephone and a modem (like the one described on p. 52).

Frank J. Derfler, Jr.
PO Box 17283
Montgomery AL 36117

The hallways of companies in the computer industry ring with phrases such as "distributed processing" and "smart terminals." Megadollar corporations are modifying their management structures to take advantage of the synergistic relationship between computers and communications. Flashy executives and congressmen too consider it a "perk" (nontaxable) to be able to dial into their mailboxes from a portable terminal and sort through their old and new messages. Military communications planners talk about many network terminals sharing a "data base in the sky." There is no reason why those of us with our own microcomputers can't participate in the exciting world of digital information transfer just like the megabuck boys.

Introduction

This is the start of a new *Microcomputing* feature called the Dial-up Directory. The Dial-up Directory will have two purposes: to provide (1) an annotated directory of those computer bulletin board services (CBBS) that exist around the country and of those individuals interested and capable of exchanging data by phone and (2) information on software and systems that can give you a dial-up capability.

We all have different interests and ways of utilizing our computers. Often our interests and requirements are not shared by local individuals or clubs. It is extremely helpful to be able to share programs and suggestions via data phone calls from around the country.

> **We would like to publish the name and phone number of anyone presently interested in receiving data calls.**

Whether your interests are graphics on the Apple, games on the PET, number crunching on the North Star or computer-assisted instruction on the TRS-80, there are others out there similarly inclined. We will try to hook you up.

We will have a lot of work to do together. We will have to work out and spread the word not only on electronic protocols, but also on those human protocols that exist whenever people interact with one another. We will describe ideal ways of doing things, the cheap way of doing things and the road down the middle. First, though, let's describe the world we will be looking at for those who may not be familiar with it.

Getting Started

Almost all of the computers we own have a practical communications capability of one sort or another. The cassette recorder port on most machines is one example.

The main I/O capability we are interested in is the RS-232 ASCII port available either stock or as an accessory on almost every microcomputer. Cassette and disk formats may differ between brands of computers and, indeed, even between models of the same brand, but the RS-232 ASCII port brings everything out in a common electrical medium of exchange. My OSI can talk to your TRS-80 at a useful speed, and we can exchange programs and information over a communications link.

Probably the best (but certainly not the only) communications medium we have between us is the telephone line. The U.S. still has the best overall phone system in the world (Japan and some sections of the Middle East are coming up fast), and the telephone represents an economical way of sending our minds out around the country.

In order to convert and send the digital plus and minus voltages of the RS-232 signal over the phone lines, we need a device called a modem, which converts these dc voltages into audio

From:	EDST	EST/ CDST	CST/ MSDT	MST/ PDST	PST	HST AST
To GMT Add: Hours	+4	+5	+6	+7	+8	+10

Table 1. Conversion from local to Coordinated Universal Time (GMT).

tones. The tones are received by a modem at the distant end and converted back into dc. The Bell system set the standards for low-speed (to 300 baud) modems; their Bell 103A standard is typically used. Under this standard, each party (one called the "originate" and one called the "answer") uses a different set of tones.

This means that if I wanted to call you to send you the nifty program that I just wrote to water my vegetable garden, we would first have to verbally agree on the speed (110 and 300 baud are the most common) and on which one of us would use the originate signaling tones and which one would use the answer tones. Then we would connect our modems to our phones and send data.

Obviously, one of us would have to have a modem capable of operating in the answer mode. This is important, because as you read modem ads you should look for the capability you need. Many modems are originate only. Many others advertise themselves as originate/answer but don't make it clear that the option requires extensive rewiring. "Switchable originate/answer" is the key phrase for complete flexibility.

Potential Difficulties

Establishing contact by phone probably only means you are over the hardware hurdle. Another favorite buzz phrase in large system procurement today is that hardware is easy . . . it's software that's difficult. Once you receive my data on your system, what can you do with it? With the right software, your system can save it on disk or tape to recall and use again at your convenience. We will talk about software to do that in future articles.

Without the right software, you can only print out the data you receive. But at least you have a hard copy to refer to. If your computer acts only as a "dumb terminal," then you can probably have a nice chat, but you may have only a few scribbled notes to remember it by.

Other difficulties may be thrown into our exchange of data if I am not free to get on the phone at the same time you are. There are two ways around this: an auto answer capability to allow access with the terminal unmanned (after all, what good is automation if you can't put yourself out of a job?) and a store and forward service.

These services exist in many places around the country. They are typically known under the generic name of computer bulletin board services (CBBS). I can dial into this service (actually, anybody's system with an automatic answer modem, the right program, sufficient memory and a large electric bill), select the bulletins I want to read and leave a copy of my rutabaga-watering program.

In that way, you and everybody else on the system can review my program at your convenience. This is practically the ideal information exchange. Would you like to take part? That is the goal of this series.

The Directory

We would like to publish the name (use a pseudonym if you like, but no CB call signs, please) and phone number of anyone presently capable of and interested in receiving data calls. We will need any specifics or limitations, such as baud rate, answer only, special control codes or carriage returns. We need to know when and on what days you will be interested in receiving calls. We will also have room for information on interests—stock market analysis, for example.

One of our biggest services can be getting people with similar interests in touch with each other—digitally. Because of the various time zones involved, I suggest we use Coordinated Universal Time (also known as GMT, Zulu or WWV time). A quick-reference GMT-to-local-time conversion chart is included in Table 1.

Remember: You may be getting calls from around the country, so it is only common courtesy to keep your 5-year-old from answering the phone during the times you specified, and it might be nice to not answer at all if you are not interested or able to transfer data on a specific day. A firm promise to return the call at another time is probably the least you owe someone who called you in good faith. An automatic audio answering device such as a Code-a-phone will allow recording up to 30 seconds of received data. We'll also discuss transferring data from the Code-a-phone to the computer in a later article.

In this introductory article, let me acquaint you with three excellent computer bulletin board services (see Directory). They represent a good starting point because they each contain extensive prompts and guides to make your telecommunications trials less terrifying. They are all available 24 hours a day, work either 110 or 300 baud and operate in the answer mode. They are free of any financial charge and don't need any passwords or codes, but that can all change if they are abused. The rules are just like those for a campground: keep it clean, don't leave any garbage behind and don't overstay your welcome, because others are waiting to use the facilities.

You can enter any of these systems by dialing the phone number, connecting your modem as soon as you hear the answering tones begin and sending at least three carriage returns. The host computer will read the carriage returns and reply at the proper speed. It is then that the fun begins.

Let me hear from you if you want to receive data calls or if you operate a CBBS. Send mail to PO Box 17283, Montgomery AL 36117, or leave a message on the Atlanta CBBS (404) 939-1520. ■

Location	Operated by	Phone
Dallas	Ric Martin and Bill Kennedy	(214) 641-8759
Atlanta	Les Freed	(404) 939-1520
Oregon	Jim Willing and Bill Marx	(503) 646-5510

Dial-up Directory.

Tiny Dual-Trace Oscilloscope

The micro-sized NLS MS215 scope is for microcomputer troubleshooting.

Nat Wadsworth
PO Box 3153
Milford CT 06460

I purchased my NLS MS215 dual trace oscilloscope at a local electronics distributor. It was in its original factory carton, which I opened at the distributor's counter to make sure that it came with probes. (It did, but with simple alligator clips at the working end!) I was unsure whether probes were included with the basic unit because some of the advertisements by mail-order suppliers indicated that scope probes were extra. The extra probes referred to in some ads, it turns out, are the fancy 10:1 probes many people like to use.

I also gave the unit a once-over glance while at the distributor's counter. However, I did not attempt to operate the unit at the point of purchase.

Inspection

When I got the unit home, I gave it a thorough visual inspection. The only physical defect I could find was a tiny chip on one of the corners of a front panel slide switch. The flaw was big enough to notice but not sufficient to upset me. I don't think I would have passed the unit with such a defect if I were the quality-control man at the factory. On the other hand, I could understand a weary inspector missing the flaw if he or she had to examine hundreds of units per day as they came down the production line. After all, I had not noticed the imperfection during my once-over glance when I purchased the unit.

I was pleased with what I found in the manual. It is well written and sufficiently comprehensive. The 36-page booklet does a creditable job covering the basic aspects of how to use the instrument, discusses the theory of operation of the circuits used in the scope and describes calibration and maintenance procedures. This is all done on a much more thorough level than in the manuals for other pieces of gear that I have had the occasion to examine lately. The manual even includes a full schematic, printed circuit board pictorials that include call-outs of active components and troubleshooting hints for each major section of the instrument's circuitry!

Power up

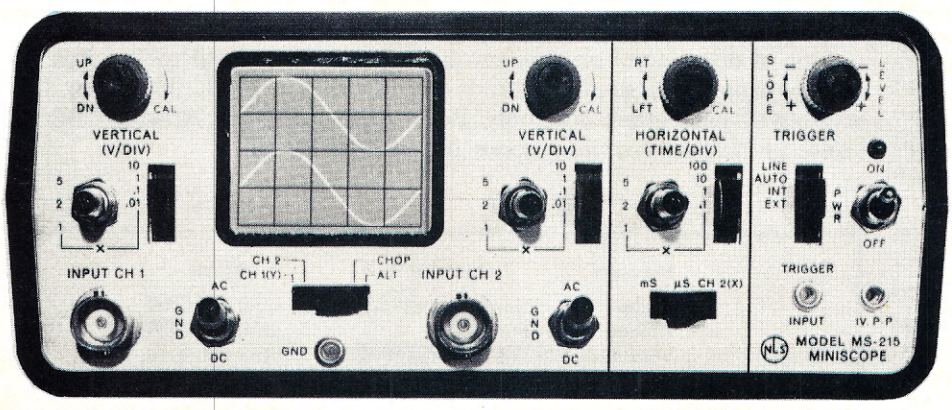
Time to turn the unit on and try it out. The instruction manual said to be sure the batteries were charged up first or else to run the scope off its ac adapter. I plugged in the adapter and gave it a few minutes to get some initial juice into its batteries per the manual's recommendations. Finally, it was time to turn the unit on.

After powering it up, I noticed an extremely high-pitched whistling noise. It was faint but clearly discernible. My first thoughts were that it might drive some people, particularly those sensitive to high-frequency sounds, slightly berserk. Fortunately, the sound is indeed very faint. I was alone in a completely quiet room when I first turned on the unit. Subsequent use has shown that just a slight amount of ambient noise, such as a softly playing radio, drowns out the high-pitched sound that emanates from the scope. The noise apparently comes from the unit's power supply that utilizes digital switching techniques operating at frequencies that are barely detectable by people. (It may be interesting to see how a dog reacts to the unit. They apparently can hear higher frequencies than people, much more clearly.)

I also noticed that the scope trace was tilted. When viewed against the etched reference grid on the unit, the trace was about one-quarter of an inch higher at the left side of the display than at the right side. To me, there are few things more annoying when trying to read a scope than having the display run downhill (or any way but *straight*) across the display tube! It is disorienting, to say the least, and it makes it tough to do any kind of serious voltage measurements.

I can assure you I was not pleased with what I initially saw. I don't know if the particular unit I purchased left the factory in that condition. I certainly hope not. Perhaps jarring the unit during shipping caused the cathode ray tube to rotate slightly. In either case, the company might want to keep an eye on the problem. I don't think mine was an isolated case. I recently noted the same firm's model 15 scope on display at an electronics show. The signal being displayed was tilted in a noticeable manner. I wonder how many prospective customers were turned off.

It turns out that it is fairly simple to correct such a situation. The problem comes about from the cathode ray tube not being positioned correctly. Undoing a screw on the instrument's case permits the cabinet to be slid



This front view of the MS215 shows that all the essential controls are right up front where needed.

off. Doing so reveals the compact and neatly laid-out circuitry.

The miniature cathode ray tube is held at its base by a socket, which is mounted in a clamping arrangement. A single screw on the socket clamp applies pressure to the clamping mechanism that holds the socket. Backing off the screw allows the tube socket to be rotated, and the display can thus be adjusted so that a straight raster line runs horizontally.

After adjustment, retighten the clamping screw. The adjustment takes just a few minutes; however, it is annoying to have to do it. After all, the display is the essence of an oscilloscope. I think the factory would want to pay close attention to see that it was OK when shipped and that it stayed properly oriented during shipment. In all other respects the unit is fine. In fact, the little scope is ideal for my applications.

Specifications

While I did not make tests with precision equipment, it appeared that the equipment was within specifications. However, some of the specifications stated seemed to be merely an exercise in "specmanship."

For instance, the vertical calibration is stated to be within three percent of full scale. Full scale on this little scope is all of one inch. That means that if you are trying to measure a voltage that is one volt peak-to-peak, on a full-scale setting, the vertical distance might vary by three one-hundredths of an inch. Not many people can readily discern that difference on an oscilloscope of this size. . . nor should they try to!

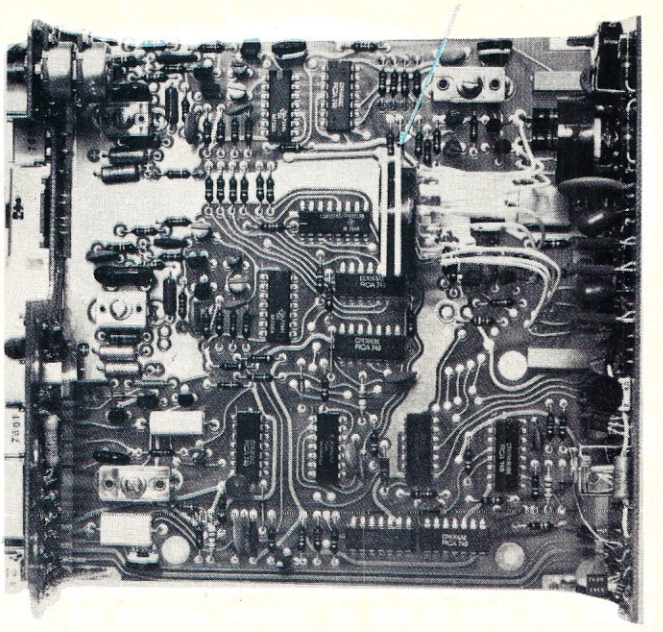
Most of my work is with digital logic in microcomputer systems. Occasionally I need to check analog signals, such as when checking power supplies, A/D or D/A converters; and, once in a while, I will check out a radio or audio system. Being a dual trace oscilloscope, the MS215, is a real boon to me. I can put a system clock signal on one trace. I can then use the other trace to follow a signal path through a logic network and check it directly against the system clock. Misbehaving counters, shift registers and just plain logic gates can't escape detection using this method.

The vertical sensitivity on each channel can be selected to be anywhere from 10 millivolts per division to 50 volts per division. This sensitivity selection is independent on each channel. It is set through a pair of switches. A four-position slide switch selects a sensitivity of 0.01, 0.1, 1.0 and 10 volts per division. A three-position toggle switch multiplies the slide switch selection by a factor of 1, 2 or 5. Additionally, a vernier knob allows the sensitivity to be continuously varied between settings of the switches if desired. When the vernier knob is placed in the CAL position, the sensitivity is specified to be within three percent of the switch settings.

If you are making critical voltage measurements, it is generally necessary to re-zero the scope trace each time the sensitivity setting on a channel is changed. This is readily accomplished by placing the channel's mode select switch into its center GND position and then tweaking the vertical position knob to set the trace at the desired zero-reference level on the display graticule.

The horizontal sweep rate can be selected to be anywhere from 0.5 second per division to 0.1 microsecond per division. Again, a vernier knob allows calibrated operation or any speed between the switch settings in an uncalibrated fashion.

The horizontal sweep can be initiated by an external signal, by a signal being displayed, at a rate synchronous with the 60 cycle line frequency if the unit is being run from an ac line source, or the sweep can be placed in a free-running mode. The free-running mode gives a continuous display regardless of what a signal is doing, and is thus useful for viewing the voltage levels of essentially steady-state signals. This is a feature that is convenient to have when tracing logic levels through a series of static gates.



A top view of the MS215 circuit board. CRT tube and batteries have been removed for this photo. Arrow points to rear mounting bracket for the CRT tube. Loosening a single screw on this bracket allows the CRT tube to be rotated slightly to correct a tilted display if necessary.

Mode of Operation

The scope can display a signal on channel one by itself, on channel two by itself, or it can display two signals simultaneously in either the so-called "chop" or "alternate" modes.

In the alternate mode, the scope shows one sweep of the signal on channel one, the next sweep on channel two and so forth. That is, it continuously alternates between displaying the two signals. The rate at which it alternates essentially depends on the horizontal sweep rate that has been selected by the operator. Of course, when the sweep rate is rapid enough, the two channels appear to be constantly displayed due to the latent image mechanism of the human eye.

In the chop mode, the oscilloscope also alternately displays the signals, only now the alternating is done at a fixed rate regardless of the settings of the horizontal sweep switches. This mode is fine for viewing signals that are relatively low in frequency, i.e., signals that are below approximately 20,000 cycles per second. Above that rate you are likely to observe gaps in the signals being displayed as the scope alternates between the two signals. (Of course, that doesn't present any problem. It means you just switch over to the alternate mode of operation because signals requiring that rate of speed on the horizontal sweep will be fast enough to give a solid appearance in the alternate mode!)

You can adjust the triggering point of a signal being displayed so that the sweep starts on a negative or positive portion. You can even select the signal level at which triggering is to occur. I found the internal triggering capability of the scope to be quite good as long as the signal varied over about two vertical divisions or more. The manual says that at least one division of deflection is required to get reliable internal triggering. My scope will indeed trigger on signals at that level, but it is difficult to select a particular point on a signal when the deflection is that low. At two or more vertical divisions I find I can get good triggering control at points that I desire on most waveforms.

Other Features

You also have the option of using the XY mode. In this mode the horizontal sweep is controlled by an external signal of your choosing, instead of an

The NLS model MS215 weighs three pounds and is easily carried in one hand. (Photos courtesy of Non-Linear Systems, Inc., Del Mar CA 92014)

internal time base. This feature is necessary to satisfy all those people who want to look at Lissajous patterns or do TV vector analysis and so forth.

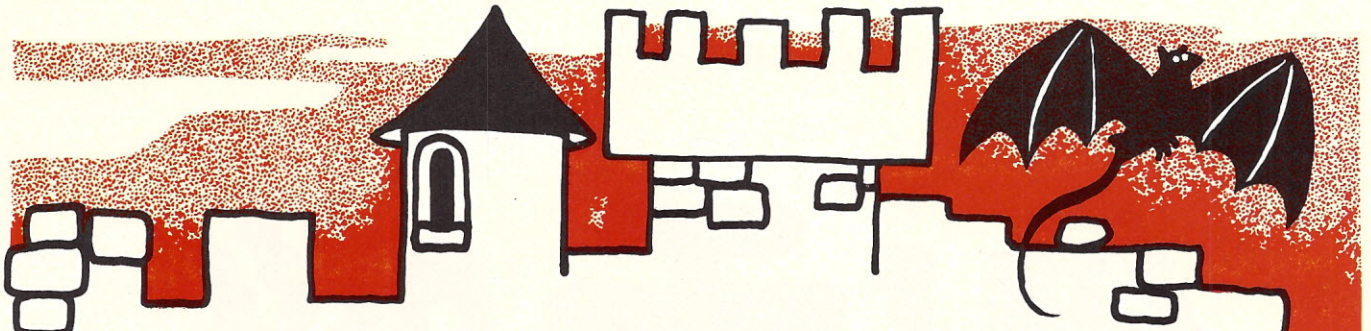
Would you believe this little scope even has a built-in one volt peak-to-peak square wave calibrating signal? This feature is convenient, especially when a signal you are tracing suddenly disappears and you want to quickly make sure that the scope itself hasn't gone on the blink! (Isn't it amazing how we always question the performance of the test equipment we are using even though we know that the piece of gear we are using it on is not working in the correct fashion?)

This small, compact scope is also able to operate from its own internal batteries. It is simply fantastic! I can't count the number of times, prior to obtaining this scope, that I have wanted to check something out in an electronic gadget, only to be stopped by the inconvenience of not having a portable scope. Who wants to lug a 30 pound oscilloscope out to the garage, connect two or three extension cords in series and then try to work on a car radio in the front seat while trying to peer into the back seat to observe a scope trace?

Have you ever been working on a piece of digital circuitry on your bench and come to the conclusion that your logic probe alone wasn't going to solve the problem? Then, have you noted that every ac receptacle on your bench was in use (out of necessity, of course) and yet your oscilloscope was not plugged in? In order to be able to plug in your scope, you have to unplug your soldering iron. And then, as soon as you have done that, just after the soldering iron has cooled down, you find that you have to solder or unsolder a connection in order to make further tests! Frustrating, isn't it?

You won't have those problems if you have an MS215! You can pick this little three pound beauty up in one hand, forget all the extension cords, run out to the garage and place it right on the front seat beside the radio you are working on—so you can probe circuits and view the results without straining your neck! You have three hours of scope operating time available when in the battery mode of operation. Since the scope is solid-state and has essentially "instant-on" capability, you can turn the scope off when not actually taking measurements. Thus, you can work practically all day in an isolated environment without needing any ac power.

All in all, I am favorably impressed by the NLS MS215 dual trace scope. I have not seen anything to match it in its price class (about $430 at the time of this writing). The closest competition I have seen or heard of is well over twice its price. ■



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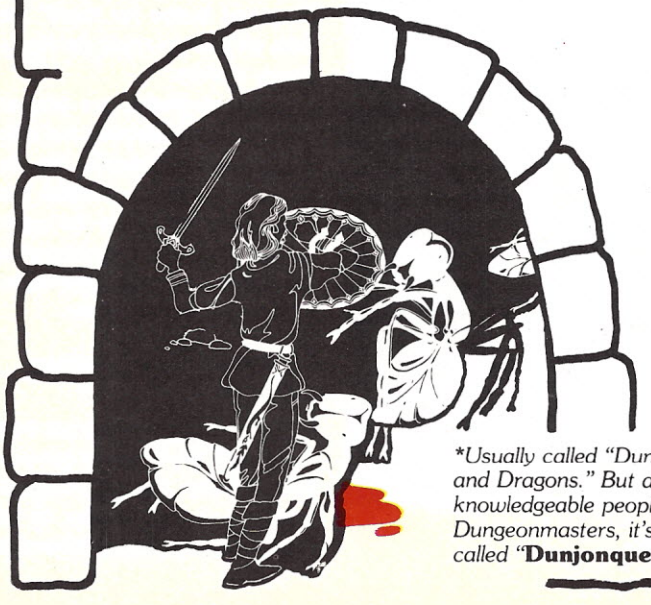

*Usually called "Dungeons and Dragons." But among knowledgeable people and Dungeonmasters, it's called "**Dunjonquest.**"*

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微電腦
Chinese Character Generation

Here's another way to employ the Sorcerer's user-defined graphics keys.

Timothy Huang
9529 NE Gertz Circle
Portland OR 97233

There are two major reasons why I chose the Sorcerer microcomputer rather than others. First, it has the interchangeable ROM language pack, which I can plug, unplug or exchange to another language in seconds. No other systems have yet been able to come close to this advantage. For example, with the Apple or the Radio Shack TRS-80, once the language firmware is installed, you are stuck with it, like it or not. It is almost, but not quite, impossible to change them. However, we (the users of Sorcerer) should remind Exidy that if they cannot provide other languages sooner, there will be a lot of complaints. Are you listening, Exidy?

The second reason I chose the Sorcerer was its user-defined graphics keys, which are not shown in other systems. If you are thinking of getting into graphics, and your system does not provide this feature, then you will have to spend more money to buy disks and programs (as with the Apple II).

Once, when I was in a downtown Portland computer-camera store (I am a shutterbug, too), the salesman tried to sell me an Apple computer. He said that his store conducted a six month's market research before deciding to sell the Apple. He put a disk into the machine and showed me all the magic graphics on the screen. He almost believed that I was sold. But after he learned that I already had a 32K Sorcerer, his attitude changed 180 degrees. He scoffed, "You spent more than a thousand bucks for that?" He then offered to trade an Apple for my system.

I was surprised, not only at his bad sales approach, but also his ignorance. Despite the six month's study, he missed the great features of the Sorcerer. By the way, I an not criticizing the Apple, but rather that salesman and the store owner.

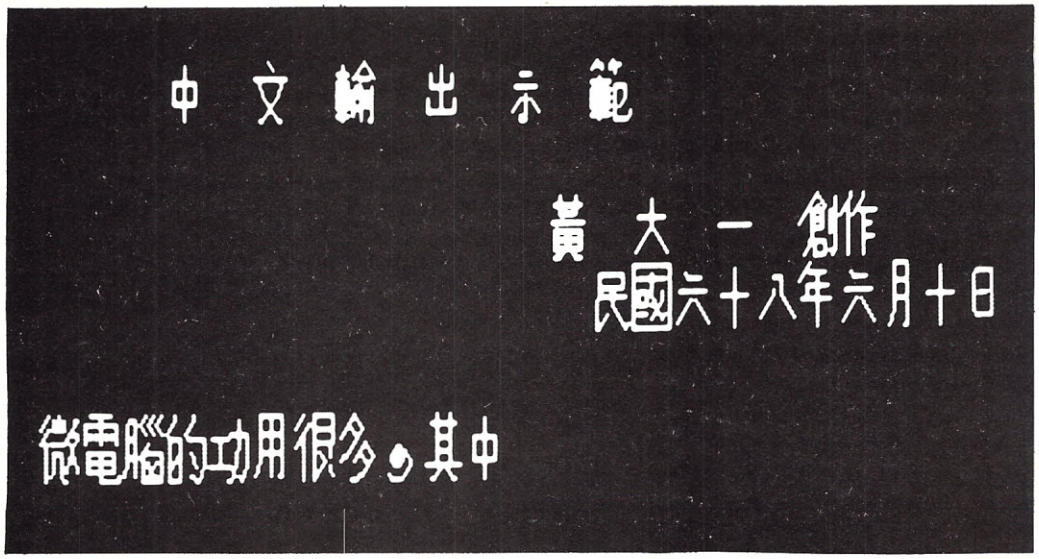


Photo 1. Chinese characters on the Sorcerer.

The Sorcerer as a Ping-Pong Diplomat

The instruction manuals that come with the Sorcerer tell you how to use the user-defined graphics. If you happen to be Japanese, you can put the entire

Japanese alphabet into it, and then type (or print out) a letter to your loved ones. The Sorcerer also accommodates all other alphabetical languages.

But I am neither Japanese nor a Yankee; I am Chinese. "Oh, well," as you Yankees would say, "the Chinese don't use the alphabet. Besides, they read and write backwards." True, we do not use the alphabet, but instead we use two-dimensional (square) graphical characters. According to scientists, the human eye can accept a pictorial message easier than a linear one. Besides, a quarter of the world's population is doing it.

However, we all paid a higher price for this precious cultural gem: We spent considerable time just learning and practicing to write the characters. For each character, each stroke, sequence and even every dot should be placed exactly right. No mistakes are allowed; otherwise you may end up expressing just the opposite of what you meant. Because of its unique features, we also don't have portable typewriters for our language. Let me tell you about the typewriter used in Taiwan, my homeland.

Typing a letter requires using a box about 2 feet by 2 feet containing about 2000 types, each with an imprinted character. The operator has to move a drum to the desired character position and press at the bottom to trigger the pick-up-and-hit-the-paper mechanism. Just think how heavy 2000 lead-antimony-tin alloy types are. Maybe this is why there are no portable typewriters for the Chinese language; they would sacrifice the beautiful calligraphy.

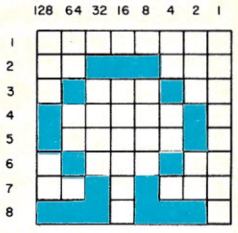
My parents always said my handwriting was so terrible that they could not read my letters. So I made up my mind to give my parents, and the Chinese people, a good solution: a portable Chinese typewriter!

Sorcerer helped me to bring that dream one step closer to my long-desired goal. After tinkering with the machine for a while, I discovered (if the people at Exidy have not already accomplished this) a way to define the graphics keys without using the monitor program. With the BASIC language, you can define the desired graphics and save them with your main program without first loading the graphics through the monitor and doing your program through the BASIC. Plus, you can change the graphics within your BASIC language. This really simplifies the process.

Changing the Graphics

1. You still have to use the section paper to draw your graphics symbols.

2. Add up the numbers by decimal, not hex. The rightmost column is 1. Each subsequent column to the left is doubled. The leftmost column is 128. See Fig. 1.



HEX	DECIMAL
00	0
38	56
44	68
82	130
82	130
44	68
28	40
EE	238

Fig. 1. 8 × 8 dot matrix and data for Ω.

```
100  READ A
200  FOR J = 1 TO 8
250  READ B
300  POKE (W + J),B
400  NEXT J
500  POKE A,N
600  DATA 3888,0,56,68,130,130,68,40,238
700  END
```

Program 1. BASIC program to define graphic symbol Ω.

3. See Program 1 to put Ω onto the screen: In line 300, W + J values should be equal to the memory addresses (eight bytes). If you want to put Ω into key 192 (!key), then let W = −513. For the 193 key ("key), let W = −505, etc. In line 500, A is the position that you want this graphic to be placed on the screen; N is the key number. (Try key 192; you will see the omega sign.) If you do not use POKE you can use the PRINT statement(s) to print it out. If so, you should omit the first number (3888) in line 600. Also, scratch line 100.

4. Make sure all the numbers

```
150 FOR X = 1 TO 30 : PRINT : NEXT
160 N = 0
170 RESTORE
180 W = 1025 : O = 128 : P = 129 : Q = 130 : R = 131
200 IF N = 32 GOTO 160
250 GOTO 500
260 N = N + 1
270 W = W -32 : O = O + 4 : P = P + 4 : Q = Q + 4 : R = R + 4
280 GOTO 200
500 READ A
510 FOR J = 1 TO 32
520 READ B
530 POKE ( J - W ), B
540 NEXT J
550 POKE-A,O:POKE(1-A),P:POKE(64-A),Q:POKE(65-A),R
560 GOTO 260
1080 DATA3888,0,1,1,1,1,31,17,17,0,0,0,0,240,16,16,17,17,31
1082 DATA1,1,1,1,0,16,16,240,0,0,0,0,0
1100 DATA3884,2,1,0,0,127,16,16,8,0,0,128,0,252,16,16,32,8,4,2
1102 DATA1,2,4,24,0,32,64,128,0,128,64,48,0
1120 DATA3880,0,32,32,249,34,248,169,170,32,80,136,4,250,0,196
1122 DATA84,251,170,170,251,34,250,32,0,212,84,84,212,68,68,76,0
1140 DATA3870,0,1,1,17,17,17,31,1,0,0,0,16,16,16,240,0,1,33,33,33
1142 DATA63,0,0,0,0,8,8,248,0,0,0
1160 DATA3872,0,0,0,7,0,0,31,0,0,0,0,192,0,0,240,0,1,5,9,17,33
1162 DATA5,7,0,0,64,32,16,8,0,0,0,0
1180 DATA3868,32,121,137,0,16,255,16,255,128,240,64,64,0,0,124,68
1182 DATA146,255,146,255,16,255,16,0,68,68,72,80,65,65,126,0
1810 DATA3614,8,8,63,8,15,0,127,0,32,32,248,32,224,0,252,0,63,33
1812 DATA63,33,63,4,56,0,248,8,248,8,248,64,56,0
1830 DATA3610,0,1,1,1,1,63,1,1,0,0,0,0,0,248,0,0,2,4,8,16,32,64,0
1832 DATA0,128,64,32,16,8,4,0,0
1850 DATA3606,0,0,0,0,0,0,0,127,0,0,0,0,0,0,0,252,0,0,0,0,0,0,0,0
1852 DATA0, 0,0,0,0,0,0,0
1870 DATA3602,1,2,4,9,23,36,71,132,0,130,66,34,202,74,202,74,7,4,4
1872 DATA11,10,18,35,0,202,10,2,226,34,42,228,0
1880 DATA3600,8,8,16,49,82,148,16,16,64,64,128,0,254,64,64,120,16,16
1882 DATA16,16,16,16,16,64,64,124,64,64,64,64,0
2140 DATA3484,0,0,31,16,16,31,16,31,0,0,248,8,8,248,128,252,32,32
2142 DATA32,34,36,40,48,0,128,128,64,32,16,10,4,0
2150 DATA3482,255,128,129,191,129,9,189,165,254,2,2,250,2,2,18,18
2152 DATA164,189,128,188,129,128,255,0,146,162,66,170,18,2,254,0
2160 DATA3480,0,0,8,7,0,0,63,0,0,0,0,224,0,0,248,0,2,4,8,16,32,64
2162 DATA0,0,128,64,32,16,8,4,0,0
2170 DATA3478,0,1,1,1,1,1,1,1,63,0,0,0,0,0,0,0,248,1,1,1,1,1,1,1,0
2172 DATA0,0,0,0,0,0,0,0
2180 DATA3476,0,0,0,3,0,0,2,2,0,0,0,192,64,64,64,64,4,8,16,32
2182 DATA64,0,0,0,32,16,8,4,2,0,0,0
2190 DATA3474,8,16,47,65,129,31,17,17,0,0,224,0,0,240,0,0,127,1
2192 DATA1,1,1,1,1,0,248,0,0,0,0,0,0,0,0
2200 DATA3472,0,0,8,7,0,0,63,0,0,0,0,224,0,0,248,0,2,4,8,16,32,64
2202 DATA0,0,128,64,32,16,8,4,0,0
2210 DATA 3470,7,4,4,4,7,4,4,4,224,32,32,32,224,32,32,32,7,4,4,4
2212 DATA8,8,16,0,224,32,32,32,32,32,96,0
2220 DATA3468,0,1,1,1,1,1,1,63,0,0,0,0,0,0,0,248,1,1,1,1,1,1,1,0
2222 DATA0,0,0,0,0,0,0,0
2230 DATA3466,0,0,7,8,8,8,8,11,0,0,240,16,16,16,16,208,8,8,8,8,7
2232 DATA0,0,0,16,16,16,16,240,0,0,0
2650 DATA3254, 17,37,69,151,32,64,175,32,0,70,68,200,30,34,212,8
2652 DATA39,36,36,36,36,40,32,0,136,148,148,162,162,128,96,0
2660 DATA3252,31,1,127,65,85,85,65,0,240,0,252,4,84,84,4,0,63,33
2662 DATA63,33,63,1,1,0,248,8,248,2,254,0
2670 DATA3250,0,57,74,73,72,120,72,72,146,36,72,36,146,0,64,128
2672 DATA73,123,73,73,137,137,1,0,254,2,74,82,34,90,254,0
2680 DATA3248,16,16,32,64,129,124,68,68,32,32,64,128,0,254,2,2,68
2682 DATA76,84,100,68,68,124,0,66,34,34,18,4,100,24,0
2690 DATA3246,0,0,0,0,0,127,8,8,0,16,16,16,254,18,18,18,8,8,8,255
2692 DATA0,0,1,0,34,34,34,162,68,84,136,0
2700 DATA3244,31,17,17,17,31,17,17,17,240,16,16,16,240,16,16,16
2702 DATA31,17,17,33,33,65,0,0,240,16,16,16,16,48,0,0
2710 DATA3242,17,33,69,137,17,49,81,145,254,2,2,254,2,2,254,4,17
2712 DATA17,17,17,17,17,17,0,68,36,16,36,68,130,0,0
2720 DATA3240,2,5,8,20,34,65,2,4,0,0,128,64,128,0,32,80,8,49,66
2722 DATA0,0,0,7,0,136,68,40,16,32,192,0,0
2730 DATA3238,0,0,0,0,0,0,0,0,3,0,0,0,0,0,0,0,0,0,7,15,15,7,0,16,15,0
2732 DATA192,160,144,16,32,64,128,0
2740 DATA3236,4,4,31,4,4,7,4,4,32,32,248,32,32,224,32,32
2742 DATA7,4,4,127,2,4,24,0,224,32,32,254,64,32,24,0
2750 DATA3234,0,1,1,1,1,31,17,17,0,0,0,0,0,240,16,16,17,17,31
2752 DATA1,1,1,1,0,16,16,240,0,0,0,0,0
```

Program 2. Chinese character output demonstration.

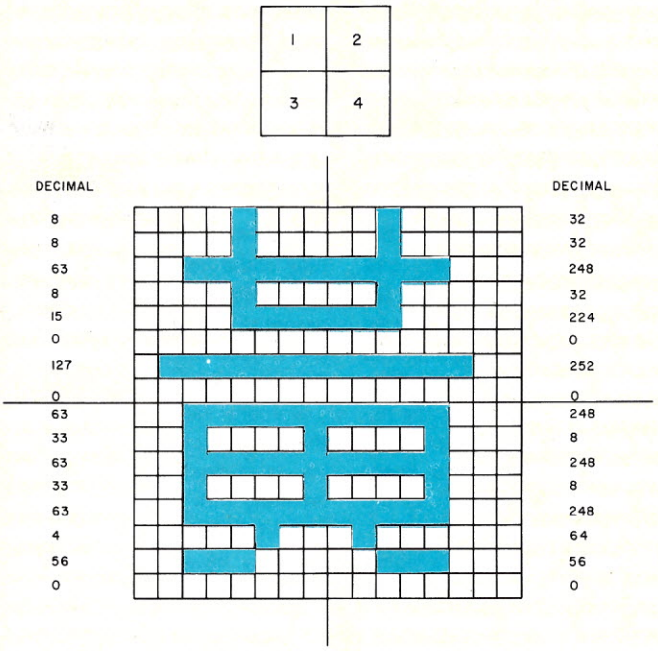


Fig. 2. Chinese character in a 16 × 16 dot matrix.

used in this program are decimal, not hex.

Chinese Character Generation and Output

First, enter the program, Chinese Character Output Demonstration (CSAVE name: CHI32). Make sure there are no mistakes when you enter the long data statements, such as using "." instead of "," between two numbers. Then type RUN (and RETURN). See Photo 1 for comparison. It's obvious that cramping a Chinese character into an 8 × 8 dot matrix is not reasonable, so I used a 16 × 16 dot matrix for each Chinese character (Fig. 2). Each quarter of this 16 × 16 matrix is numbered 1,2,3 and 4, starting at the upper left-hand corner. Each quarter is further divided into an 8 × 8 dot matrix as the Sorcerer will do.

If you can understand Program 1 (for the omega sign), you should not have too much trouble understanding this one. I put line 150 into the program to clear the screen first, since I have not discovered the "screen clearing" statement for the Sorcerer yet. (Does anyone know?) Line 200 is used to limit the output numbers of the characters to less than 32 for this demonstration. I tried to put more characters on the screen, but have not had any success yet. The problem is that 32 characters will use up 128 (16 × 8) user-definable graphics keys. I wonder if the people at Exidy know a way (in BASIC, please) to change the data for each key without wiping out the earlier graphics data. I tried several approaches, but if I try to change the data, then all the characters on the screen will also change to identical characters. I end up with a screen full of the same characters.

Conclusions

By the way, the translation of the characters in Photo 1 is:

Chinese Character Output Demonstration
By Timothy Huang
June 10 of the year 68 of the Republic of China.
The usages of Microcomputers are many, one of which . . .

Before I try another program that can handle more characters, I wonder if anyone has ever encountered the error message: ? MO ERROR IN XX-XX. After consulting the list of Appendix D: Error Messages of the Sorcerer of "A Short Tour of BASIC" from Exidy, I cannot find out what it means.

Well, if anyone who can use this program would like to share his or her discoveries about the special graphics powers of the Sorcerer, I would appreciate hearing from you. ■

At Intersystems, "dump" is an instruction. Not a way of life.

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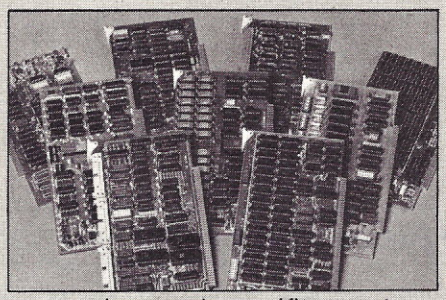

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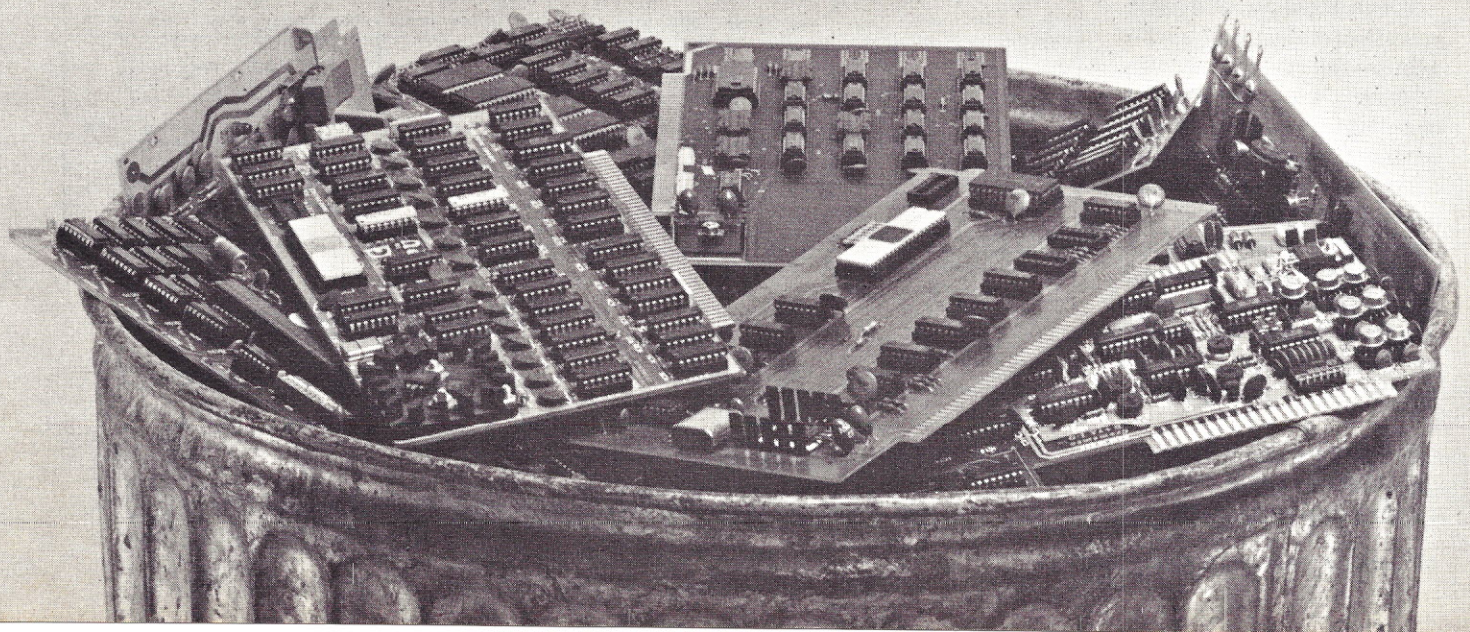


Using Five-Level Teleprinters with a TRS-80

Why spend a kilobuck on a fancy printer when surplus 15s and 28s abound. Baudot lives on!

Brian Bateman
PO Box 399
Sharpes FL 32959

Unless you are one of the lucky ones, you don't have a lot of money to spend on a personal computer system. Yet, in spite of the groans from your bank account, and maybe your wife, you invested in the Radio Shack "bare essentials" TRS-80 Level II 16K machine. After all, who really needs those extra goodies such as a line printer, which can cost more than the computer itself?

Within a couple of months, you are operating your system with a fair degree of confidence. It is not until you have to debug one of your "biggie" programs or print a biorhythm chart that you start to appreciate the real worth of hard copy. Still, it might be difficult to justify upwards of $1600 for a printer. But all is not lost, since I am going to show you how you can have hard copy for your machine at a very reasonable price.

The Radio Shack TRS-80 has the printer interface in its expansion interface. It also has sockets for 32K more memory, an extra cassette interface, a real-time clock and a single chip disk controller. So just to get the printer interface you have to buy a box costing $300, which is definitely a bit much for the guy who just wants hard copy. Even without this expense, the printers themselves are not inexpensive. Radio Shack sells one for close to $1300, which represents a single expense of more than the total you have so far invested in the system.

Teletype for Your TRS-80

Fortunately, some of the older Teletypes are becoming surplus items and are being sold at very reasonable prices. Probably the most abundant of these Teletypes are the five-level Teletype Models 15 and 28.

The Model 15 was last manufactured in 1957, and about a quarter million were produced. It is a slow machine, typically 60 wpm. This speed, as with all five-level Teletypes, is the maximum speed, i.e., if no shifted characters are printed, since the Teletype must waste one character time in order to per-

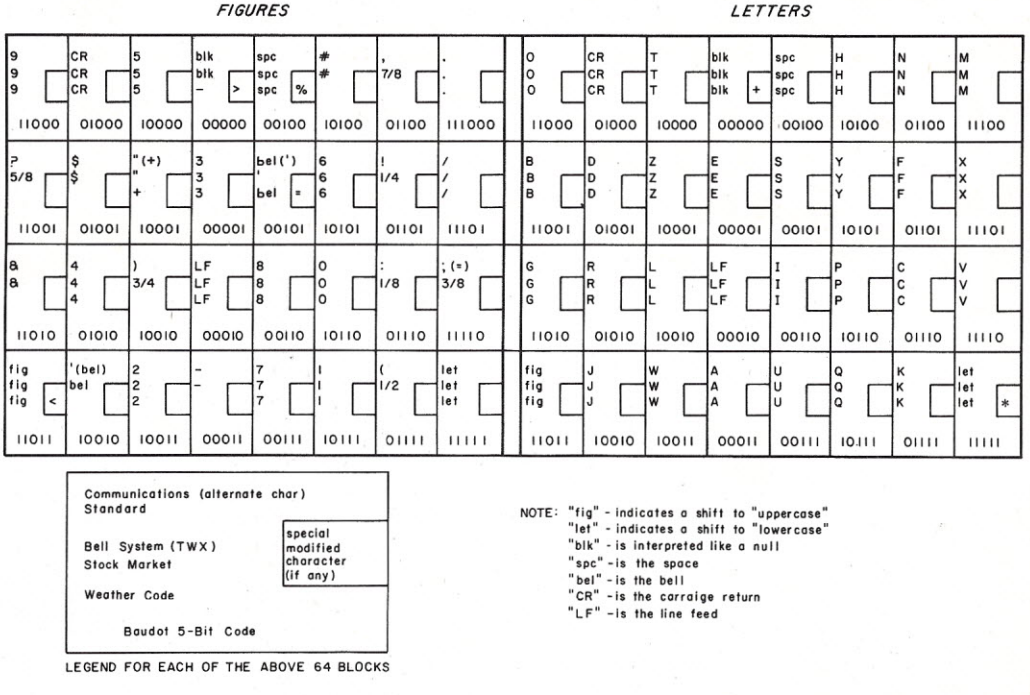


Fig. 1. Diagram of the Model 28 type box (viewed from character side).

form the shift. Although slow, it gets the job done, producing a readable hard copy.

The Model 28 (Photo 1) is the most desirable of the five-level machines, since it is faster (typically 75 or 100 wpm), reasonably quiet and still being produced, making service and spare parts plentiful. The only difference between the 75 wpm and 100 wpm Model 28 is two gears, which can be obtained from Teletype service centers.

All of these Teletypes can be purchased for between $50 and $200, depending on your resourcefulness and the condition of the machine. This is a bargain, since the original price of these machines was from $2000 to $3500. The Models 15 and 28 are both heavy-duty machines capable of 24-hours-a-day operation.

The primary disadvantage of the five-level machines is that they do not have the full ASCII character set; in fact, they have only about 54 characters. With some careful manipulation, however, you can substitute these characters for some of the ASCII characters that it does not have; after a little practice you will be able to read a five-level listing almost as well as an ASCII listing.

Fig. 1 shows the five-level character set and how the bits are arranged for each character. Notice that each bit pattern has two key-codes assigned to it. This demonstrates that a particular code is interpreted differently depending on whether or not the Teletype is currently in a shifted or unshifted condition. In order to change this condition, you must send either a "letters" (unshift) key-code or a "figures" (shift) key-code.

Now you can see why that quoted speed was a maximum speed. For example, if the Teletype is in an unshifted condition and typing letters, then no shift would need to be sent, but if you had to type a number, then you would have to first shift then type the number. The machine would then remain in the shifted condition until either the letters code or a space code was sent.

On most of the five-level Teletypes, every time a space is sent the Teletype automatically unshifts, no matter what its previous condition was. This is a waste of time when you have to type several numbers with spaces in between them. The Teletypes are set up to operate with or without this feature, but I suggest that you keep it in since this puts the machine in a periodic known unshifted condition. This allows the machine to synchronize itself with the computer without the need for extra wiring and hardware that would be necessary to allow the computer to check the status of the carriage or type box.

How Five-Level Works

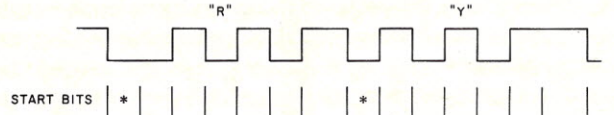
Most of the five-level machines operate on a current loop, that is, a closed circuit between the power supply and the selector magnet. Data is transmitted to the Teletype by breaking and closing this loop at carefully timed intervals. Just about all of these machines operate with a current of approximately 60 mA in the loop, although some of the Model 28s operate with a 20 mA loop.

Fig. 2 shows a typical timing sequence for the letters R and Y. Also included is a chart showing the length of these times for the different Teletype speeds. Notice that the start bit is a break in the current loop, and after one bit time, the first bit of the transmitted character arrives. After precisely five bit times (six total), the current loop is forced closed for one stop bit time. This allows the machine enough time to set up for the next character. The times listed for the stop bit length are minimums.

Actually, the stop bit length is unimportant as long as it is greater than or equal to the minimum; however, to avoid slowing the Teletype down too much, this time should be kept as close to the minimum time as possible. The transmission of alternating Rs and Ys is a good worst-case test of the five-level machine, paralleling the transmission of the As and 5s in an ASCII machine.

When you first get your machine it will be wise to play with it a little bit before hooking it up to your computer. If your Teletype has a keyboard, which most of them have, then you should hook the keyboard in series with the printing

Photo 1. Teletype KSR Model 28.



WORDS PER MINUTE	DATA RATE (BAUD)	CHAR/SEC	START AND DATA BIT TIMES	STOP BIT TIME
60	45	6.0	22.0 ms	31 ms
75	57	7.5	18.0 ms	25 ms
100	75	10.0	13.5 ms	19 ms

TYPICAL PROGRAM DELAY COUNTS FOR THE TRS-80:

60 words/minute:	DEL 1	10 HEX
	DEL 2	BB HEX
	DEL 3	02 HEX
	DEL 4	33 HEX
100 words/minute:	DEL 1	0A HEX
	DEL 2	88 HEX
	DEL 3	02 HEX
	DEL 4	22 HEX

Fig. 2. Timing sequence for the letters R and Y.

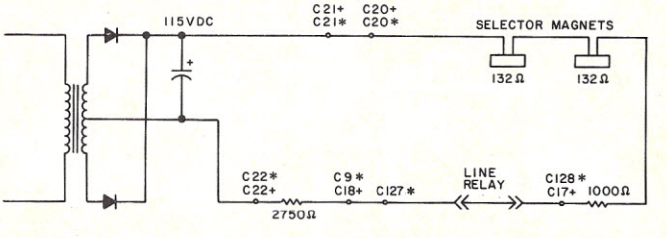


Fig. 3. Simplified wiring diagram for the Model 28 five-level Teletype.

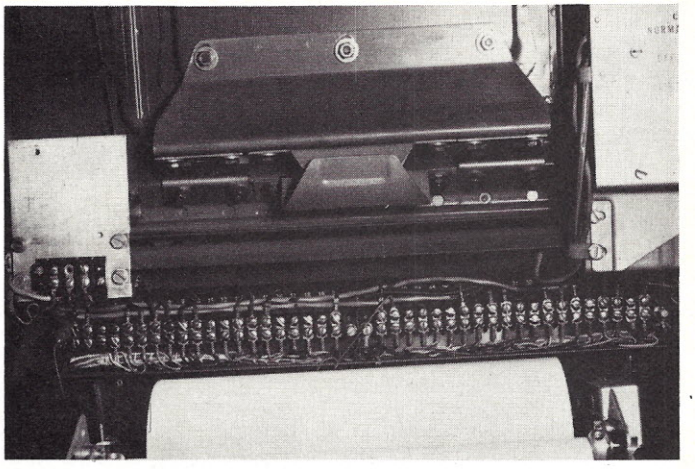


Photo 2. Screw terminal strip (visible behind paper roll with cover lifted).

mechanism in the current loop so you can type directly on the keyboard to the printing mechanism. In the event that you have a nonworking keyboard or no keyboard at all, then you should connect a switch wired with insulated alligator clips in series with the current loop.

Close the switch and turn on the Teletype, which should come on and be relatively quiet with only the hum of the motor. If, instead, it rattles like crazy, then the current loop is not closed. Even though the current is small in the loop, the voltage is 115 volts, so care should be taken when connecting and using the switch.

Fig. 3 shows the typical circuits for the Model 15 and 28 five-level Teletype. I have indicated some good points for completing the 60 mA current loop. The numbers preceded by C represent terminal connector numbers on the screw-type terminal strip (Photo 2) inside the Teletype. This number when suffixed with + indicates an RO or KSR Model 28, and when suffixed by * indicates an ASR Model 28.

Keyboard contacts for all standard Model 28 Teletypes are terminals C9 and C10. So to put the keyboard in series with the typing unit requires only that the jumper between C20 and C21 be disconnected and then two jumpers (C9 to C20 and C10 to C21) be installed. Terminal C10 is not shown in Fig. 3 since it is in the keyboard signal generator loop.

Typically, the keyboard and typing unit are not connected together in their normal configuration as they would be installed by Teletype. However, even though C9 and C10 would appear to be in different places, they are actually adjacent terminal connections on the terminal strip.

To make this a working system, the Teletype interface should be connected to terminals C17 + (C128*), which is the "+" voltage, and C18 + (C127*), which is the "–" voltage. If your loop current is much lower then 60 mA and the Teletype does not print reliably, you can connect to terminal C22 + (C22*) instead of C18 + (C127*), which bypasses a resistor, thus increasing the loop current. There is a jumper between C9* and C127* as shown, so C9* can be used instead of C127* if it is more convenient.

The Model 15 is extremely simple with respect to its wiring. It has a two conductor wire, which is connected to the selector magnets on one end and a one-quarter inch phone plug on the other end. The keyboard is connected to another one-quarter inch phone plug the same way. If the Teletype does not come with a power supply, then you must build a 120 mA, 115 volt dc power supply with about a 6000 Ohm, 25 Watt resistor in line to control the loop current, which should be adjusted to 60 mA. The selector magnets, the keyboard, the Teletype interface and the power supply should all be connected in series with each other to form the working system.

Once you have finally closed the loop, type on the keyboard if you have hooked it up, or open and close the switch rapidly and the Teletype should respond by typing some characters. At this point, it doesn't matter what it types, just so it types. If it passes this test, you can feel reasonably confident that the computer will be able to "talk" to it.

Basically, the computer has to "make and break" the circuit in precise patterns to instruct the Teletype as to what character to print. To do this we need some kind of switch. Since I don't like any more mechanical things in the system than I have to have, I chose a high voltage transistor. It

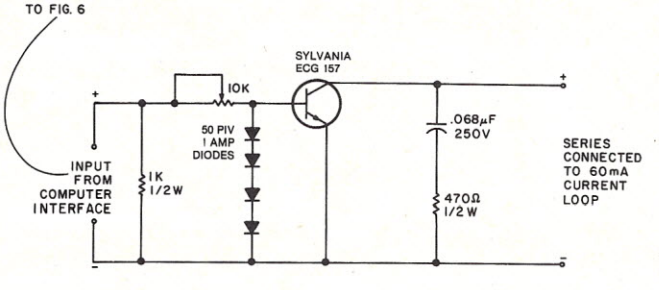
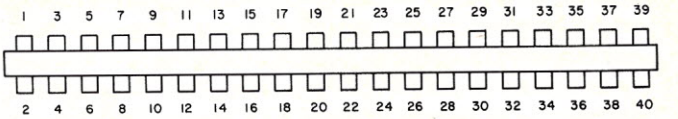


Fig. 4. Teletype interface.



Pin No.	Signal	Description
1	RAS*	Row address strobe output for 16 pin dynamic RAMs
2	SYSRES*	System reset
3	CAS*	Column address strobe output for 16 pin dynamic RAMs
4	A10	Address line
5	A12	Address line
6	A13	Address line
7	A15	Address line
8	GND	Signal ground
9	A11	Address line
10	A14	Address line
11	A8	Address line
12	OUT*	Address line
13	WR*	Address line
14	INTAK*	Interrupt acknowledge output
15	RD*	Memory read strobe output
16	MUX	Multiplexer control output for 16 pin dynamic RAMs
17	A9	Address line
18	D4	Data line
19	IN*	I/O input strobe
20	D7	Data line
21	INT*	Maskable interrupt
22	D1	Data line
23	TEST*	Tri-states the processor
24	D6	Data line
25	A0	Address line
26	D3	Data line
27	A1	Address line
28	D5	Data line
29	GND	Signal ground
30	D0	Data line
31	A4	Address line
32	D2	Data line
33	WAIT*	Processor wait for slow memory
34	A3	Address line
35	A5	Address line
36	A7	Address line
37	GND	Signal ground
38	A6	Address line
39	GND	Signal ground
40	A2	Address line

Fig. 5. Expansion port edge card (viewed from rear of TRS-80) and pin-out designations.

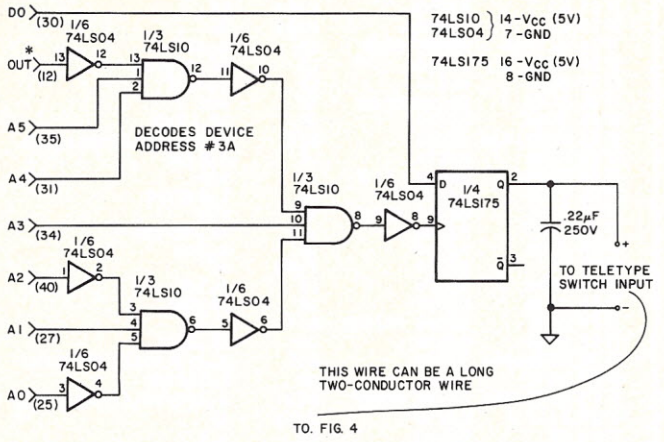


Fig. 6. Computer interface.

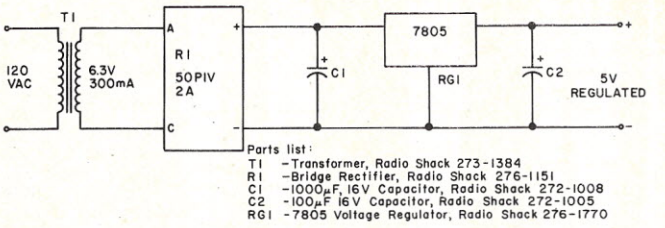


Fig. 7. 5 volt power supply circuit.

doesn't have to handle much current, but it should have a voltage rating of at least 150 volts. Fig. 4 shows this interface. It should be located relatively close to the Teletype. This interface actually does the switching of the 60 mA current loop.

Now, we need to have something to switch the transistor on and off.

The Computer Interface

On the back of the TRS-80 keyboard unit and the screen printer port on the expansion interface, there is a 40-pin bus with 20 tabs on each side of the printed circuit board. The pinout designations are shown in Fig. 5.

The Z-80 microprocessor allows for 256 non-memory-mapped I/O devices to be connected to it. To "talk" to a device the Z-80 must place its "device address" (port address) on the lower eight address lines (A_0-A_7) and at the same time pulse the I/O sync line (OUT*).

Fig. 6 shows the schematic for the computer interface. If you follow the logic of the diagram you will see that it is configured for device address 3A (hex) or 58 (decimal). You can see that the diagram is extremely simple and only requires three chips. I used LS low-power Schottky chips for low power; however, regular TTL chips would work just as well. This circuit requires a minimal 5 volt power supply (see Fig. 7).

Once you have built this circuit, which should be located near the computer, just connect a pair of wires between the two interfaces. Also connect a 40-conductor ribbon cable with connector appropriately to the computer interface as shown. One note of caution here could save your having to rewire the ribbon cable! It seems that Radio Shack has labeled their 40-pin bus upside down. In other words, pin 1 is really pin 2 and pin 2 is really pin 1 on a standard connector and so on. Once you have triple-checked your wiring, you are ready to hook it all together.

One preliminary check you can make on the interface is to turn on the Teletype and type in the BASIC command "OUT 58,15." This should cause the Teletype to go quiet, except for the motor hum (i.e., close the loop). If it does not, then you have a problem somewhere. If this works OK, then issue the command "OUT 58,0." This should cause the Teletype to rattle. Again, issue the command "OUT 58,15." If the Teletype again goes quiet, then you have a working system.

Software

Listing 1 shows the five-level driver routine. In some places it is seemingly clumsy, but I wanted to make the code positionally independent. In other words, without the use of an assembler, you can move this code around in memory, change two bytes (7F66 and 7F67) to the beginning address of the lookup table, and it will run. This was an extremely useful feature in the early days when I didn't have an assembler and even after I did finally get one. The entire driver subroutine is composed of less than 256 bytes of code.

The first 5F (hex) bytes of code are the ASCII-to-five-level lookup table. The relative location in the lookup table, with zero as the beginning, represents the ASCII character that it is equivalent to. For example, relative location 41 (hex) has the five-level equivalent for the letter A stored there. There are different types of information about the letter stored at that location, and each of the eight bits has its specific meaning (see Fig. 8).

Now that the lookup table has been established, we have to break this information down and send it to the Teletype. Relative byte 60 (hex) is the location I reserved to store the condition of the carriage, that is, shifted or unshifted. This brings us to the entry point of the code, relative byte 61 (hex), which is labeled ENTRY. The code basically stores the ASCII character within the index instruction located at the label CHAR and then checks to see if the character is a legal character (i.e., less than or equal to 5F (hex)). This check is done by adding A0 (hex) to the ASCII character and checking for overflow. At label CHAR, the five-level equivalent for the ASCII character to be printed is loaded into the accumulator. The labels SPCK, LFCK and CRCK check for special cases (i.e., space, line feed and carriage return), since a carriage condition check is not necessary for these characters. In fact, the space, as I mentioned before, also unshifts the carriage regardless of its previous state.

The label PRTCHR checks bit 7 of the five-level character to see if the character requires that the carriage be in the shifted or unshifted condition prior to printing the character. It then dispatches it appropriately to be set up for output to the Teletype.

In the location SHIFT, the shift status is stored in bit 0, and bit 7 being set signifies that two characters need to be output before returning to the

Listing 1. Five-level TTY Driver routine.

```
                    01000 ;         ***** LISTING 1 *****
                    01010 ;
                    01020 ;  ***** BAUDOT TTY DRIVER *****
                    01030 ;  IT EXPECTS CHARACTER TO BE IN REGISTER "A"
                    01040 ;
003A                01050 PORT      EQU     3AH
000A                01060 DEL1      EQU     0AH
00B8                01070 DEL2      EQU     0B8H
0002                01080 DEL3      EQU     2
0022                01090 DEL4      EQU     22H
                    01100 ;
7F00                01110           ORG     7F00H
7F00 40             01120 ORIGIN    DEFB    40H
7F01 40             01130           DEFB    40H
```

```
7F02 40          01140          DEFB    40H
7F03 40          01150          DEFB    40H
7F04 40          01160          DEFB    40H
7F05 40          01170          DEFB    40H
7F06 40          01180          DEFB    40H
7F07 CA          01190          DEFB    0CAH
7F08 40          01200          DEFB    40H
7F09 40          01210          DEFB    40H
7F0A 44          01220          DEFB    44H
7F0B 40          01230          DEFB    40H
7F0C 40          01240          DEFB    40H
7F0D 50          01250          DEFB    50H
7F0E 40          01260          DEFB    40H
7F0F 40          01270          DEFB    40H
7F10 40          01280          DEFB    40H
7F11 40          01290          DEFB    40H
7F12 40          01300          DEFB    40H
7F13 40          01310          DEFB    40H
7F14 40          01320          DEFB    40H
7F15 40          01330          DEFB    40H
7F16 40          01340          DEFB    40H
7F17 40          01350          DEFB    40H
7F18 40          01360          DEFB    40H
7F19 40          01370          DEFB    40H
7F1A 40          01380          DEFB    40H
7F1B 40          01390          DEFB    40H
7F1C 40          01400          DEFB    40H
7F1D 40          01410          DEFB    40H
7F1E 40          01420          DEFB    40H
7F1F 40          01430          DEFB    40H
7F20 48          01440          DEFB    48H
7F21 DA          01450          DEFB    0DAH
7F22 E2          01460          DEFB    0E2H
7F23 E2          01470          DEFB    0E2H
7F24 D2          01480          DEFB    0D2H
7F25 40          01490          DEFB    40H
7F26 F4          01500          DEFB    0F4H
7F27 D6          01510          DEFB    0D6H
7F28 DE          01520          DEFB    0DEH
7F29 E4          01530          DEFB    0E4H
7F2A D6          01540          DEFB    0D6H
7F2B F4          01550          DEFB    0F4H
7F2C D8          01560          DEFB    0D8H
7F2D C6          01570          DEFB    0C6H
7F2E F8          01580          DEFB    0F8H
7F2F FA          01590          DEFB    0FAH
7F30 EC          01600          DEFB    0ECH
7F31 EE          01610          DEFB    0EEH
7F32 E6          01620          DEFB    0E6H
7F33 C2          01630          DEFB    0C2H
7F34 D4          01640          DEFB    0D4H
7F35 E0          01650          DEFB    0E0H
7F36 EA          01660          DEFB    0EAH
7F37 CE          01670          DEFB    0CEH
7F38 CC          01680          DEFB    0CCH
7F39 F0          01690          DEFB    0F0H
7F3A DC          01700          DEFB    0DCH
7F3B FC          01710          DEFB    0FCH
7F3C DE          01720          DEFB    0DEH
7F3D DC          01730          DEFB    0DCH
7F3E E4          01740          DEFB    0E4H
7F3F F2          01750          DEFB    0F2H
7F40 40          01760          DEFB    40H
7F41 46          01770          DEFB    46H
7F42 72          01780          DEFB    72H
7F43 5C          01790          DEFB    5CH
7F44 52          01800          DEFB    52H
7F45 42          01810          DEFB    42H
7F46 5A          01820          DEFB    5AH
7F47 74          01830          DEFB    74H
7F48 68          01840          DEFB    68H
7F49 4C          01850          DEFB    4CH
7F4A 56          01860          DEFB    56H
7F4B 5E          01870          DEFB    5EH
7F4C 64          01880          DEFB    64H
7F4D 78          01890          DEFB    78H
7F4E 58          01900          DEFB    58H
7F4F 70          01910          DEFB    70H
7F50 6C          01920          DEFB    6CH
7F51 6E          01930          DEFB    6EH
7F52 54          01940          DEFB    54H
7F53 4A          01950          DEFB    4AH
7F54 60          01960          DEFB    60H
7F55 4E          01970          DEFB    4EH
7F56 7C          01980          DEFB    7CH
7F57 66          01990          DEFB    66H
7F58 7A          02000          DEFB    7AH
7F59 6A          02010          DEFB    6AH
7F5A 62          02020          DEFB    62H
7F5B DA          02030          DEFB    0DAH
7F5C 48          02040          DEFB    48H
7F5D 48          02050          DEFB    48H
7F5E 48          02060          DEFB    48H
7F5F 48          02070          DEFB    48H
7F60 00          02080 SHIFT    DEFB    0
7F61 DDE5        02090 ENTRY    PUSH    IX
7F63 F5          02100          PUSH    AF
7F64 DD21007F    02110          LD      IX,ORIGIN
7F68 DD7778      02120          LD      (IX+CHAR+2-ORIGIN),A
7F6B C6A0        02130          ADD     A,0A0H
7F6D 3004        02140          JR      NC,START
7F6F F1          02150          POP     AF
7F70 DDE1        02160          POP     IX
7F72 C9          02170          RET
7F73 C5          02180 START    PUSH    BC
7F74 D5          02190          PUSH    DE
7F75 E5          02200          PUSH    HL
7F76 DD7E00      02210 CHAR     LD      A,(IX+0)
7F79 11FEF6      02220          LD      DE,0F6FEH
7F7C 0E3A        02230          LD      C,PORT
7F7E FE48        02240 SPCK     CP      48H
7F80 2006        02250          JR      NZ,LFCK
7F82 DDCB6086    02260          RES     0,(IX+SHIFT-ORIGIN)
7F86 182A        02270          JR      OUTCHR
7F88 FE44        02280 LFCK     CP      44H
7F8A 2826        02290          JR      Z,OUTCHR
7F8C FE50        02300 CRCK     CP      50H
7F8E 2007        02310          JR      NZ,PRTCHR
7F90 3E44        02320          LD      A,44H
7F92 F5          02330          PUSH    AF
7F93 3E50        02340          LD      A,50H
7F95 1810        02350          JR      DOUCHR
7F97 CB7F        02360 PRTCHR   BIT     7,A
7F99 2054        02370          JR      NZ,SBIT
7F9B DDCB6046    02380          BIT     0,(IX+SHIFT-ORIGIN)
7F9F 2811        02390          JR      Z,OUTCHR
7FA1 DDCB6086    02400 UNSHF    RES     0,(IX+SHIFT-ORIGIN)
7FA5 F5          02410          PUSH    AF
7FA6 7B          02420          LD      A,E
7FA7 DDCB60FE    02430 DOUCHR   SET     7,(IX+SHIFT-ORIGIN)
7FAB 1805        02440          JR      OUTCHR
7FAD DDCB60BE    02450 NEXT     RES     7,(IX+SHIFT-ORIGIN)
7FB1 F1          02460          POP     AF
7FB2 2E07        02470 OUTCHR   LD      L,7
7FB4 0F          02480 LOOP     RRCA
7FB5 3010        02490          JR      NC,SPACE
7FB7 26FF        02500 MARK     LD      H,0FFH
7FB9 ED61        02510          OUT     (C),H
7FBB 060A        02520          LD      B,DEL1
7FBD C5          02530 TIM1     PUSH    BC
7FBE 0688        02540          LD      B,DEL2
7FC0 10FE        02550 DL1      DJNZ    DL1
7FC2 C1          02560          POP     BC
7FC3 10F8        02570          DJNZ    TIM1
7FC5 180E        02580          JR      ENBIT
7FC7 2600        02590 SPACE    LD      H,0
7FC9 ED61        02600          OUT     (C),H
7FCB 060A        02610          LD      B,DEL1
7FCD C5          02620 TIM2     PUSH    BC
7FCE 0688        02630          LD      B,DEL2
7FD0 10FE        02640 DL2      DJNZ    DL2
7FD2 C1          02650          POP     BC
7FD3 10F8        02660          DJNZ    TIM2
7FD5 2D          02670 ENBIT    DEC     L
7FD6 20DC        02680          JR      NZ,LOOP
7FD8 0602        02690          LD      B,DEL3
7FDA C5          02700 TIM3     PUSH    BC
7FDB 0622        02710          LD      B,DEL4
7FDD 10FE        02720 DL3      DJNZ    DL3
7FDF C1          02730          POP     BC
7FE0 10F8        02740          DJNZ    TIM3
7FE2 DDCB607E    02750 NCHAR    BIT     7,(IX+SHIFT-ORIGIN)
7FE6 20C5        02760          JR      NZ,NEXT
7FE8 E1          02770          POP     HL
7FE9 D1          02780          POP     DE
7FEA C1          02790          POP     BC
7FEB F1          02800          POP     AF
7FEC DDE1        02810          POP     IX
7FEE C9          02820          RET
7FEF DDCB6046    02830 SBIT     BIT     0,(IX+SHIFT-ORIGIN)
7FF3 20BD        02840          JR      NZ,OUTCHR
7FF5 DDCB60C6    02850 SET      SET     0,(IX+SHIFT-ORIGIN)
7FF9 F5          02860          PUSH    AF
7FFA 7A          02870          LD      A,D
7FFB 18AA        02880          JR      DOUCHR
7F61             02890          END     ENTRY
00000 TOTAL ERRORS

SET     7FF5
NCHAR   7FE2
DL3     7FDD
TIM3    7FDA
DL2     7FD0
TIM2    7FCD
ENBIT   7FD5
DL1     7FC0
TIM1    7FBD
MARK    7FB7
SPACE   7FC7
LOOP    7FB4
NEXT    7FAD
UNSHF   7FA1
SBIT    7FEF
DOUCHR  7FA7
PRTCHR  7F97
CRCK    7F8C
OUTCHR  7FB2
LFCK    7F88
SPCK    7F7E
START   7F73
CHAR    7F76
ENTRY   7F61
SHIFT   7F60
ORIGIN  7F00
DEL4    0022
DEL3    0002
DEL2    00B8
DEL1    000A
PORT    003A
```

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RSL-1: Enter graphic patterns with repeating keyboard! Save patterns on tape (4 furnished). Play LIFE, a game of birth, growth and death of a colony of cells. FAST - about 1 second per generation! Hours of fascinating patterns!

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Level-II 16K machine language versions of Adventure, the current rage of the big time-share computers! 6 versions: 1-Adventureland, 2-Pirate's Adventure, 3-Mission Impossible, 4-Voodoo Castle, 5-The Count, and 6-Strange Odyssey. Each is a challenge that can take weeks to solve! Furnished on tape; convert to disk with DCV-1.

UTILITIES

RSM-2: AN ADVANCED TAPE MONITOR FOR 16K TRS-80'S - $26.95
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22 commands to control your TRS-80 Z-80 processor! Examine ROM's, test RAM, program in machine language, read/write machine language tapes, and much more! SYMBOLIC DUMP will disassemble memory into Z-80 mnemonics! HEX and two ASCII memory dumps; EDIT, MOVE, EXCHANGE, VERIFY, FILL, ZERO, TEST, or SEARCH memory, read/write SYSTEM tapes, enter BREAKPOINTS, PRINT with TRS232 or Centronics, and read/write disk sectors directly! Radio Shack uses RSM; see page 4-17 of your disk manual! RSM-2 tape loads at top of 16K LEVEL I or II; RSM-2D disk includes 3 versions for 16K, 32K and 48K.

RSM-2 RELOCATOR: PUT RSM-2/2D ANYWHERE IN MEMORY - 9.95

This new program loads with the RSM-2/2D "L" tape command, then asks you where you want RSM-2 located. Your answer causes a new version to be created and executed! Instructions included for saving your new versions.

DCV-1: CONVERT SYSTEM PROGRAMS TO DISK FILES -$9.95

EDTASM, The Electric Pencil, Air Raid, RSL-1, ESP-1, T-BUG, or nearly any SYSTEM tape can be executed from disk, even if it interferes with TRSDOS! DCV-1 loads system tapes into high memory and adds a block-move routine. TAPEDISK is then used to create a disk file. When accessed from disk, the program loads into high memory, moves itself to its correct address, then jumps there and executes! New version works with TRSDOS 2.2.

BASIC-1P: LEVEL-1 BASIC WITH PRINTING! - $19.95

Loads into the top 4K of 16K TRS-80's and uses any LEVEL-I BASIC program or DATA tape (up to 12K in length) without conversion! NEW commands, LPRINT and LLIST to print with either our TRS232 or the Radio Shack printer! Loads from tape or disk (furnished on tape). All LEVEL-I abbreviations and functions supported!

CALIFORNIA Residents please add 6% state sales tax.

MODEL-II TRS-80

Small System Software is currently developing several programs for the Model II TRS-80. An enhanced RSM monitor with many new features will be available about January. We are adapting CP/M (tm Digital Reaserch, Inc.) in conjunction with Lifeboat Associates. CP/M for the Model II will be a "standard" version and will run all existing CP/M software, including Cobol, Fortran, C-Basic, M-Basic, business and accounting packages, etc. Write for details!

PROFESSIONAL SOFTWARE

MICROSOFT SOFTWARE PACKAGES - $80.00 each, **$150.00** for both

ASSEMBLER PACKAGE: Macro Assembler uses Zilog mnemonics and produces relocatable code! Includes Linking Loader, Editor and Cross Reference Utilities. Requires 32K and 1 disk drive.

FORTRAN PACKAGE: A true Fortran Compiler (faster than Basic). Linking Loader combines Fortran, Assembly and Library modules into one program! Editor and extensive Library are included. Requires 32K and at least 1 disk drive.

THE ELECTRIC PENCIL FOR TRS-80 DISK SYSTEMS - $150.00
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Write text, delete, insert, or move words, lines or paragraphs, save text on tape (or disk), then print formatted copy with our TRS232 or Centronics printer (RS-232-C with disk version). Right justification, page titling and numbering, transparent cursor and repeating keyboard. Upper case only, or lowercase with modification. Level-1 or 2 16K (tape version).

CP/M OPERATING SYSTEM WITH TRS232 SOFTWARE - $145.00

SMALL SYSTEM SOFTWARE/LIFEBOAT ASSOCIATES version of CP/M. Includes TRS232 and RS-232-C software, lower-case support, debounce, DCV-2 and other unique utilities. CP/M Editor creates and modifies all files. Assemble from disk, placing HEX and PRINT files back onto disk! Includes DDT (Dynamic Debugging Tool), PIP (Peripheral Interchange Program), and more! CP/M is a trademark of Digital Reasearch, Inc.

PRINTER SUPPORT

TRS232 PRINTER INTERFACE - $49.95 (+$2.00 shipping)

Assembled and tested output port for TRS-80 printing. Use Diablo, Teletype, TI Silent or any RS-232 or 20-mil current loop ASCII printer. Expansion interface not required. Use with LEVEL-II BASIC, CP/M, BASIC-1P, ELECTRIC PENCIL, RSM-2/2D or your own programs! Standard cassette software included, or order new "FORMATTER" (below) for enhanced printer control.

TRS232 "FORMATTER" SOFTWARE PACKAGE - $14.95

Enhanced software for with Level-2 Basic and our TRS232. Page and line length control, form feed function, printer pause, "smart" line termination, indented continuation lines, keyboard debounce, echo screen to printer, etc. Includes BASIC cassette and BASIC and machine language source listings.

PRINTER CONVERSION PACKAGES - $9.95 EACH

Many programs do not include provisions for printing with either our TRS232 or the Radio Shack RS-232-C. We currently offer the following tapes for adding printing functions:

RSM RS-232-C: Adds RS-232-C capability to RSM-2/2D
PENCIL RS-232-C: For cassette version of Electric Pencil
EDTASM PRINT: TRS232 and RS-232-C for disk/tape EDTASM

OTHER TRS-80 PRODUCTS

ESP-1: $29.95 Assembler, Editor & Monitor (8080 mnemonics)
LST-1: 8.00 Listing of Level-1 BASIC with some comments

SMALL SYSTEM SOFTWARE BANKAMERICARD **P. O. BOX 366** MASTER CHARGE **NEWBURY PARK, CA 91320**

```
                    01000 ;        ***** LISTING 2 *****
                    01010 ;
                    01020 ;  ***** BAUDOT HANDLER ROUTINE *****
                    01030 ;THIS IS A HANDLER ROUTINE FOR THE BAUDOT TTY
                    01040 ;AND IS TO BE USED IN CONJUNCTION WITH THE
                    01050 ;BAUDOT DRIVER ROUTINE
                    01060 ;        IT WILL FUNCTION WITH THE TRS-80
                    01070 ;        LEVEL II BASIC
                    01080 ;        IF MEMORY IS CHANGED AS FOLLOWS:
                    01090 ;          4026H(16422) TO 0CAH(202)
                    01100 ;          4027H(16423) TO 07EH(126)
7ECA                01110          ORG     7ECAH
7F61                01120 BAUDOT   EQU     7F61H
7ECA 79             01130 BEGIN    LD      A,C
7ECB B7             01140          OR      A
7ECC FE0B           01150          CP      0BH
7ECE 280A           01160          JR      Z,L2
7ED0 FE0C           01170          CP      0CH
7ED2 2016           01180          JR      NZ,L3
7ED4 AF             01190          XOR     A
7ED5 DDB603         01200          OR      (IX+03H)
7ED8 2810           01210          JR      Z,L3
7EDA DD7E03         01220 L2       LD      A,(IX+03H)
7EDD DD9604         01230          SUB     (IX+04H)
7EE0 47             01240          LD      B,A
7EE1 3E0A           01250 L4       LD      A,0AH
7EE3 CD617F         01260          CALL    BAUDOT
7EE6 10F9           01270          DJNZ    L4
7EE8 1811           01280          JR      L5
7EEA CD617F         01290 L3       CALL    BAUDOT
7EED FE0D           01300          CP      0DH
7EEF C0             01310          RET     NZ
7EF0 DD3404         01320          INC     (IX+04H)
7EF3 DD7E04         01330          LD      A,(IX+04H)
7EF6 DDBE03         01340          CP      (IX+03H)
7EF9 79             01350          LD      A,C
7EFA C0             01360          RET     NZ
7EFB DD360400       01370 L5       LD      (IX+04H),0
7EFF C9             01380          RET
7ECA                01390          END     BEGIN
00000 TOTAL ERRORS

L5          7EFB
L4          7EE1
L3          7EEA
L2          7EDA
BEGIN       7ECA
BAUDOT      7F61
```

Listing 2. Five-level handler routine.

calling program. This situation occurs when the carriage must be shifted or unshifted before the character can be printed, or whenever a carriage return is output, since a line feed must be issued with the carriage return. This is necessary since the TRS-80 does not output a line feed after printing a carriage return. It expects the printer to automatically execute a line feed whenever it sends out a carriage return.

Any jump to DOUCHR indicates that a double character transmission is about to occur. The label OUTCHR actually performs the transmission of the character to the Teletype, including the bit timing for the start, data and stop bits. The label MARK closes the current loop for one data bit time, and the label SPACE breaks the current loop for one start or data bit time.

The label ENBIT checks to see if the stop bit has been transmitted. If it has then it will time the stop bit correctly. The label NCHAR then checks to see if another character is yet to be transmitted. The label UNSHF issues an unshift (letters) character, and the label SET issues a shift (figures) character to the Teletype.

Now that the driver routine is finished, you are ready to start talking to the Teletype. At this point, however, you can only talk to it through your own machine-language programs. To do that you need only load the accumulator (register A) with the ASCII character that you wish to print and then call this driver routine as a subroutine to your program. This is done with the instruction CALL 7F61H, or CALL ENTRY if you assemble this driver with your program.

While this is nice, most TRS-80 users will probably find little immediate benefit for this routine if it can only be used with their machine-language programs. Somehow, this driver needs to be linked to Level II BASIC and to the TRS-80 Editor/Assembler 1.1 to be a real benefit.

Let's take the case of Level II BASIC first. When the TRS-80 is powered up, it automatically initializes itself to communicate with the TRS-80 line printer through the expansion interface. Now we need to reinitialize the Level II pointers to our routine rather than its own. This pointer is located in the Lineprinter Control Block at decimal address locations 16422 and 16423. We cannot just put the entry address of the driver routine here, since there are certain things we have to handle other than just print out the character itself. The TRS-80 line-printer routine takes care of functions such as counting the number of lines printed, and if it receives the result of the command LPRINT CHR$(12), it can even skip to the top of a new page. Since I was going to the trouble of writing the driver, it seemed only reasonable that I should also include these features.

Listing 2 shows the software interface between Level II BASIC and the driver routine. In actuality, this routine will be combined with Listing 1 and assembled together. In this situation, Listing 1 appends to Listing 2 to form what we might call the print routine. When an LPRINT command is encountered by Level II BASIC, it breaks up what it is supposed to print into individual characters and then sends them to the print routine in Register-C one character at a time.

Basically, this routine's total purpose in life is to copy the character from Register-C to the accumulator Register-A and then increment the line counter each time it sees a carriage return until the count equals the lines per page count. When this occurs, the line counter is then zeroed out for the start of the next page. Both the lines per page count and the line counter are also stored in the Lineprinter Control Block, respectively, at decimal locations 16424 and 16425.

The only thing left to do now is modify the pointer address in decimal locations 16422 and 16423. This pointer requires two words of memory since it is

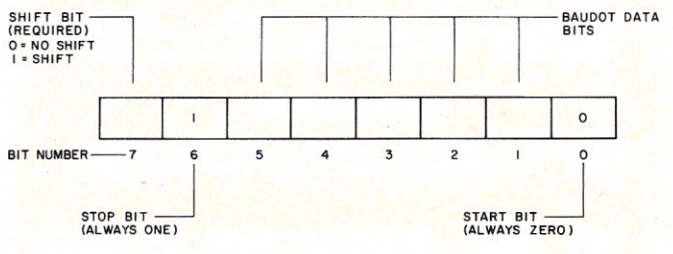

Fig. 8. Eight-bit configuration.

a full 16-bit address and each word in memory is only eight bits. The order in which these locations are loaded is very important. The Z-80 expects to see the least significant eight bits of the address in the first location and the most significant eight bits in the second location. To find out what we need to put in these locations requires some relatively simple calculations.

Since the entry point to the handler routine shown in Listing 2 is address 7ECA (hex), the first thing to do is break it up into two parts (most significant and least significant). The most significant eight bits is 7E (hex) and the least significant eight bits is CA (hex). Now unless you are using disk BASIC, you won't be able to use this information directly; you will have to convert it to decimal. Converting any two-digit hex number to decimal requires that you multiply the left-most digit by 16 (assigning A = 10, B = 11, C = 12, D = 13, E = 14 and F = 15) and add it to the right-most digit.

Following this, you will see that 7E (hex) is equal to 126 (decimal) and CA (hex) is equal to 202 (decimal). At this point, changing the pointers consists of issuing two Level II BASIC commands: "POKE(16422), 202" and "POKE(16423), 126." Now the LPRINT and LLIST commands will write directly to your Teletype as if it were the TRS-80 line printer.

For those of you who also want your assembler to list its output to the Teletype, the solution is not quite as simple. Although, with the program shown in Listing 3, you should have no problems at all.

This code to modify the assembler is divided into three sections. The first section beginning at the label SETUP simply takes the other two sections and overlays them on top of the assembler in the proper places. The second section, beginning at the label START, should look familiar since it is a copy of the software interface between Level II BASIC and the driver routine. This routine is also needed with the assembler to make it perform its printer functions properly.

The third section, consisting of the code associated with labels MEM1 and SETMEM, is mainly a nondestructive memory size routine. It will go through memory looking for the last location of RAM. Once it finds that, it will subtract the amount of memory taken up by the print routine and then pass that result to the assembler at its memory size. This is necessary since the assembler goes all the way to the end of memory to store its symbol table.

To make the patch to the assembler and then run it, reset the machine and answer the memory size query with a number that will protect your print routine when you load it. In a

```
                        01000 ;        ***** LISTING 3 *****
                        01010 ;
                        01020 ; THIS PROGRAM WILL MODIFY THE TRS-80 ASSEMBLER
                        01030 ; SO THAT AN ALTERNATE PRINT ROUTINE
                        01040 ; CAN BE USED.  THE ENTRY POINT OF THE
                        01050 ; PRINT ROUTINE SHOULD BE EQUATED TO "BAUDOT".
                        01060 ; "SIZE" SHOULD BE EQUATED TO THE SIZE OF THE
                        01070 ; PRINT ROUTINE IN BYTES PLUS 20 EXTRA BYTES.
                        01080 ; THIS ASSUMES THAT THE PRINT ROUTINE IS LOCATED
                        01090 ; AT THE END OF MEMORY.
                        01100 ;
                        01110 ; YOU MUST LOAD BUT NOT EXECUTE BOTH THE ASSEMBLER
                        01120 ; AND THE PRINT ROUTINE BEFORE LOADING AND EXECUTING
                        01130 ; THIS PROGRAM.
                        01140 ;
                        01150 ;PROGRAM NAME -- "ASMMOD"
                        01160 ;
7E00                    01170          ORG     7E00H
FF55                    01180 BAUDOT   EQU     0FF55H
0130                    01190 SIZE     EQU     130H
7E00 21197E             01200 SETUP    LD      HL,START
7E03 11AA45             01210          LD      DE,45AAH
7E06 011400             01220          LD      BC,SETMEM-START
7E09 EDB0               01230          LDIR
7E0B 215A7E             01240          LD      HL,SETMEM
7E0E 119546             01250          LD      DE,4695H
7E11 010A00             01260          LD      BC,0AH
7E14 EDB0               01270          LDIR
7E16 C38A46             01280          JP      468AH
7E19 79                 01290 START    LD      A,C
7E1A B7                 01300          OR      A
7E1B FE0B               01310          CP      0BH
7E1D 280A               01320          JR      Z,L2
7E1F FE0C               01330          CP      0CH
7E21 2016               01340          JR      NZ,L3
7E23 AF                 01350          XOR     A
7E24 DDB603             01360          OR      (IX+03H)
7E27 2810               01370          JR      Z,L3
7E29 DD7E03             01380 L2       LD      A,(IX+03H)
7E2C DD9604             01390          SUB     (IX+04H)
7E2F 47                 01400          LD      B,A
7E30 3E0A               01410 L4       LD      A,0AH
7E32 CD55FF             01420          CALL    BAUDOT
7E35 10F9               01430          DJNZ    L4
7E37 1811               01440          JR      L5
7E39 CD55FF             01450 L3       CALL    BAUDOT
7E3C FE0D               01460          CP      0DH
7E3E C0                 01470          RET     NZ
7E3F DD3404             01480          INC     (IX+04H)
7E42 DD7E04             01490          LD      A,(IX+04H)
7E45 DDBE03             01500          CP      (IX+03H)
7E48 79                 01510          LD      A,C
7E49 C0                 01520          RET     NZ
7E4A DD360400           01530 L5       LD      (IX+04H),0
7E4E C9                 01540          RET
                        01550 ;
7E4F 23                 01560 MEM1     INC     HL
7E50 7E                 01570          LD      A,(HL)
7E51 47                 01580          LD      B,A
7E52 2F                 01590          CPL
7E53 77                 01600          LD      (HL),A
7E54 BE                 01610          CP      (HL)
7E55 70                 01620          LD      (HL),B
7E56 28F7               01630          JR      Z,MEM1
7E58 AF                 01640          XOR     A
7E59 C9                 01650          RET
7E5A CDE045             01660 SETMEM   CALL    45AAH+MEM1-START
7E5D C5                 01670          PUSH    BC
7E5E 013001             01680          LD      BC,SIZE
7E61 ED42               01690          SBC     HL,BC
7E63 C1                 01700          POP     BC
7E00                    01710          END     SETUP
00000 TOTAL ERRORS

MEM1     7E4F
L5       7E4A
L4       7E30
L3       7E39
L2       7E29
SETMEM   7E5A
START    7E19
SETUP    7E00
SIZE     0130
BAUDOT   FF55
```

Listing 3. Assembler modification.

16K machine, 32000 is a good answer for this print routine. Now type "SYSTEM" (enter) and then load the print routine. The assembler should then be loaded but not executed. Finally, this routine for the patch should be loaded. Now just type "/" (enter). Within a few moments, the assembler should clear the screen and print its usual sign-on message. The assembler is now ready to go and will dump all of its printer output to the Teletype.

In order to use the print routine with Level II BASIC, a similar procedure is followed. You still protect memory with the same memory size answer as before and load the print routine into the machine under "SYSTEM." Then just press the "BREAK" key and "poke" the two locations 16422 and 16423 as was discussed earlier. Finally, you have a completely operational system.

Five-Level Phase II

The only real complaint you could have is that the output would be a little more readable to other people if you had a few extra characters in the characters.

Listing 4. Special handler routine.

```
                01000 ;       ***** LISTING 4 *****
                01010 ;
                01020 ;  ***** BAUDOT HANDLER ROUTINE *****
                01030 ;THIS IS A HANDLER ROUTINE FOR THE BAUDOT TTY
                01040 ;AND IS TO BE USED IN CONJUNCTION WITH THE
                01050 ;BAUDOT DRIVER ROUTINE
                01060 ;       IT WILL FUNCTION WITH THE TRS-80
                01070 ;       LEVEL II BASIC
                01080 ;       IF MEMORY IS CHANGED AS FOLLOWS:
                01090 ;         4026H(16422) TO 0BEH(190)
                01100 ;         4027H(16423) TO 0FEH(254)
                01110 ;
                01120 ;  THIS IS A SPECIAL ROUTINE TO UTILIZE THE BAUDOT
                01130 ;  TYPE BOX TO ITS FULLEST POTENTIAL.  IT WILL ALLOW
                01140 ;  THE ADDITION OF UP TO 6 MORE CHARACTERS TO THE
                01150 ;  TYPE BOX.
                01160 ;
                01170 ;  ALSO THIS IS SPECIFICALLY WRITTEN FOR THE BAUDOT
                01180 ;  MODEL 28 WITH THE 100 WPM GEAR SET INSTALLED.
                01190 ;  HOWEVER, THE SPEED CAN BE MODIFIED BY CHANGING
                01200 ;  DEL1, DEL2, DEL3, AND DEL4.
                01210 ;
                01220 ;PROGRAM NAME -- "BAUMOD"
                01230 ;
FEBE            01240         ORG     0FEBEH
FEBE 79         01250 BEGIN   LD      A,C       ; CHAR IN C-REG
FEBF B7         01260         OR      A
FEC0 FE0B       01270         CP      0BH       ; TOP OF FORM
FEC2 280A       01280         JR      Z,L2
FEC4 FE0C       01290         CP      0CH
FEC6 2016       01300         JR      NZ,L3
FEC8 AF         01310         XOR     A
FEC9 DDB603     01320         OR      (IX+03H)
FECC 2810       01330         JR      Z,L3
FECE DD7E03     01340 L2      LD      A,(IX+03H)
FED1 DD9604     01350         SUB     (IX+04H)
FED4 47         01360         LD      B,A
FED5 3E0A       01370 L4      LD      A,0AH
FED7 CD55FF     01380         CALL    ENTRY     ;OUTPUT CHAR
FEDA 10F9       01390         DJNZ    L4
FEDC 1811       01400         JR      L5
FEDE CD55FF     01410 L3      CALL    ENTRY     ;OUTPUT CHAR
FEE1 FE0D       01420         CP      0DH       ; CHECK CR
FEE3 C0         01430         RET     NZ
FEE4 DD3404     01440         INC     (IX+04H)   ;INC LINE COUNT
FEE7 DD7E04     01450         LD      A,(IX+04H)
FEEA DDBE03     01460         CP      (IX+03H)   ;CHECK END OF PAGE
FEED 79         01470         LD      A,C
FEEE C0         01480         RET     NZ
FEEF DD360400   01490 L5      LD      (IX+04H),0    ; ZERO LINE COUNT
FEF3 C9         01500         RET
                01510 ;
                01520 ;  ***** BAUDOT TTY DRIVER *****
                01530 ;  IT EXPECTS CHARACTER TO BE IN REGISTER "A"
                01540 ;
003A            01550 PORT    EQU     3AH       ; OUTPUT PORT
000A            01560 DEL1    EQU     0AH
00B8            01570 DEL2    EQU     0B8H
0002            01580 DEL3    EQU     2
0022            01590 DEL4    EQU     22H
                01600 ;
                01610 ; BEGINNING OF THE ASCII TO BAUDOT LOOKUP TABLE
                01620 ;
FEF4 48         01630 ORIGIN  DEFB    48H       ; NUL
FEF5 48         01640         DEFB    48H       ; SOH
FEF6 48         01650         DEFB    48H       ; STX
FEF7 48         01660         DEFB    48H       ; ETX
FEF8 48         01670         DEFB    48H       ; EOT
FEF9 48         01680         DEFB    48H       ; ENG
FEFA 48         01690         DEFB    48H       ; ACK
FEFB 48         01700         DEFB    48H       ; BELL
FEFC 48         01710         DEFB    48H       ; BS
FEFD 48         01720         DEFB    48H       ; HT
FEFE 44         01730         DEFB    44H       ; LINE FEED
FEFF 48         01740         DEFB    48H       ; VT
FF00 48         01750         DEFB    48H       ; FF
FF01 50         01760         DEFB    50H       ; CARRIAGE RET
FF02 48         01770         DEFB    48H       ; SO
FF03 48         01780         DEFB    48H       ; SI
FF04 48         01790         DEFB    48H       ; DLE
FF05 48         01800         DEFB    48H       ; DC1
FF06 48         01810         DEFB    48H       ; DC2
FF07 48         01820         DEFB    48H       ; DC3
FF08 48         01830         DEFB    48H       ; DC4
FF09 48         01840         DEFB    48H       ; NAK
FF0A 48         01850         DEFB    48H       ; SYN
FF0B 48         01860         DEFB    48H       ; ETB
FF0C 48         01870         DEFB    48H       ; CAN
FF0D 48         01880         DEFB    48H       ; EM
FF0E 48         01890         DEFB    48H       ; SUB
FF0F 48         01900         DEFB    48H       ; ESC
FF10 48         01910         DEFB    48H       ; FS
FF11 48         01920         DEFB    48H       ; GS
FF12 48         01930         DEFB    48H       ; RS
FF13 48         01940         DEFB    48H       ; VS
FF14 48         01950         DEFB    48H       ; SPACE
FF15 DA         01960         DEFB    0DAH      ; !
FF16 E2         01970         DEFB    0E2H      ; "
FF17 E8         01980         DEFB    0E8H      ; #
FF18 D2         01990         DEFB    0D2H      ; $
FF19 C8         02000         DEFB    0C8H      ; %
FF1A F4         02010         DEFB    0F4H      ; &
FF1B D6         02020         DEFB    0D6H      ; '
FF1C DE         02030         DEFB    0DEH      ; (
FF1D E4         02040         DEFB    0E4H      ; )
FF1E 7E         02050         DEFB    7EH       ; *
FF1F 40         02060         DEFB    40H       ; +
FF20 D8         02070         DEFB    0D8H      ; ,
FF21 C6         02080         DEFB    0C6H      ; -
FF22 F8         02090         DEFB    0F8H      ; .
FF23 FA         02100         DEFB    0FAH      ; /
FF24 EC         02110         DEFB    0ECH      ; 0
FF25 EE         02120         DEFB    0EEH      ; 1
FF26 E6         02130         DEFB    0E6H      ; 2
FF27 C2         02140         DEFB    0C2H      ; 3
FF28 D4         02150         DEFB    0D4H      ; 4
FF29 E0         02160         DEFB    0E0H      ; 5
FF2A EA         02170         DEFB    0EAH      ; 6
FF2B CE         02180         DEFB    0CEH      ; 7
FF2C CC         02190         DEFB    0CCH      ; 8
FF2D F0         02200         DEFB    0F0H      ; 9
FF2E DC         02210         DEFB    0DCH      ; :
FF2F FC         02220         DEFB    0FCH      ; ;
FF30 F6         02230         DEFB    0F6H      ; <
FF31 CA         02240         DEFB    0CAH      ; =
FF32 C0         02250         DEFB    0C0H      ; >
FF33 F2         02260         DEFB    0F2H      ; ?
FF34 48         02270         DEFB    48H          AT SIGN
FF35 46         02280         DEFB    46H       ; A
FF36 72         02290         DEFB    72H       ; B
FF37 5C         02300         DEFB    5CH       ; C
FF38 52         02310         DEFB    52H       ; D
FF39 42         02320         DEFB    42H       ; E
FF3A 5A         02330         DEFB    5AH       ; F
FF3B 74         02340         DEFB    74H       ; G
FF3C 68         02350         DEFB    68H       ; H
FF3D 4C         02360         DEFB    4CH       ; I
FF3E 56         02370         DEFB    56H       ; J
FF3F 5E         02380         DEFB    5EH       ; K
FF40 64         02390         DEFB    64H       ; L
FF41 78         02400         DEFB    78H       ; M
FF42 58         02410         DEFB    58H       ; N
```

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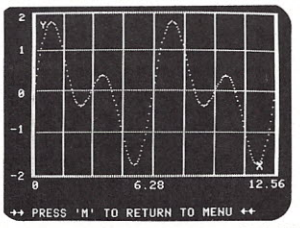

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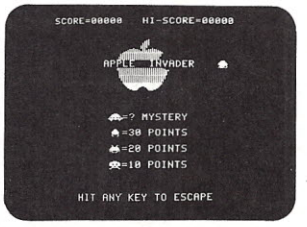

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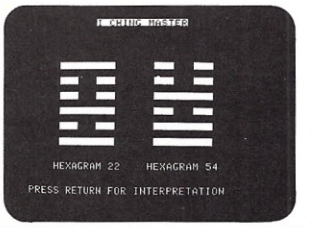

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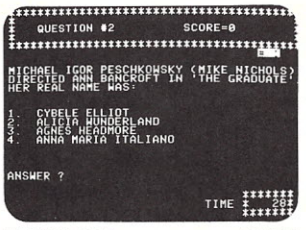

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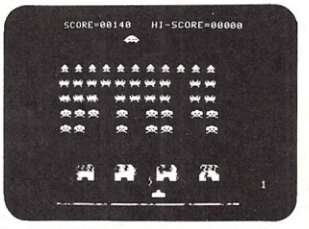

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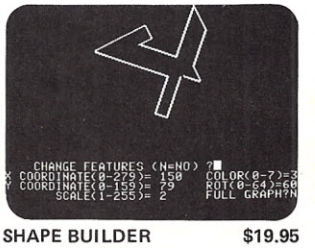

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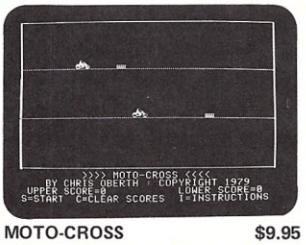

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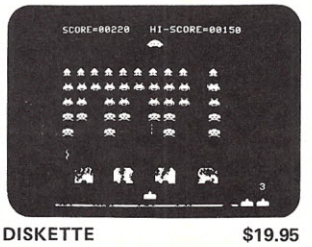

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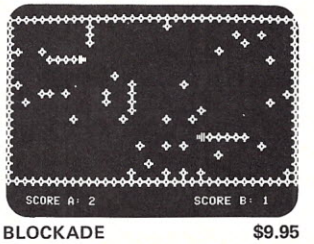

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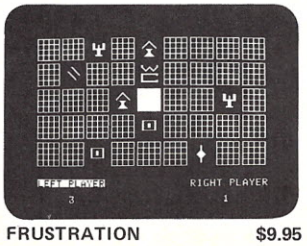

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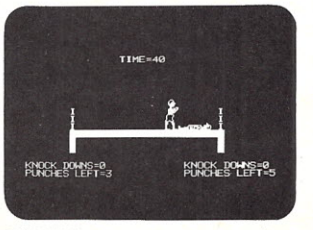

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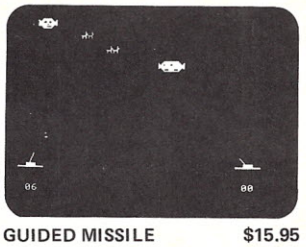

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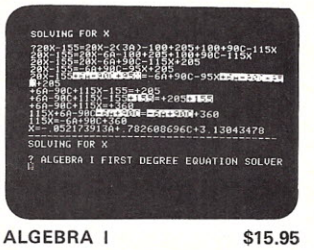

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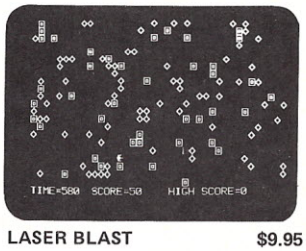

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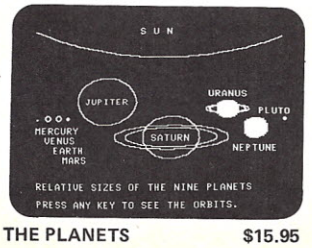

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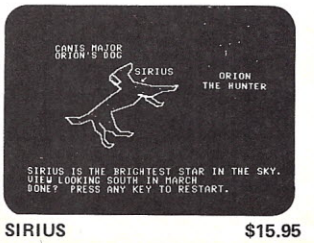

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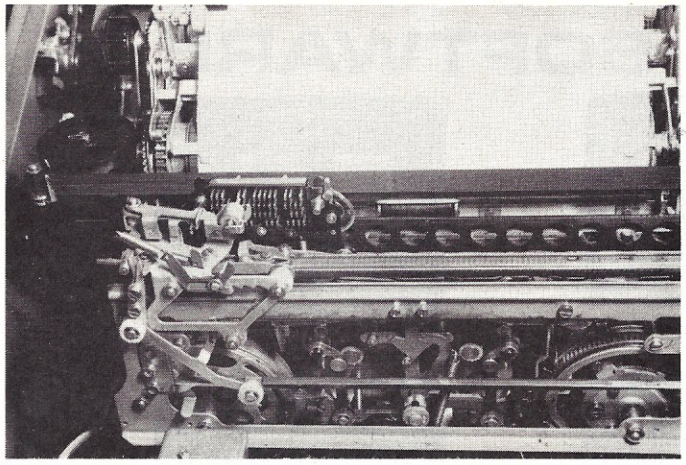

Photo 3. Installed type box with hammer over the + pallet.

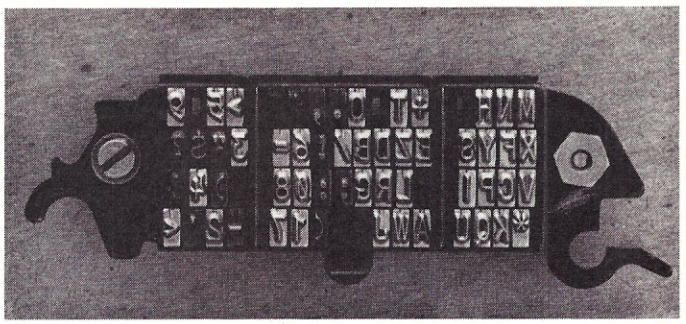

Photo 4. Type box with additional characters (pallets) installed.

ter set. Of the characters that Radio Shack uses, the five-level Teletype is missing the <, >, %, =, +, *, @, and ., which I will have to agree are some very useful symbols to have. I finally decided that they would be useful enough to warrant some study on just how I might go about making the five-level Teletype print these characters.

I am by no means implying that the five-level Teletype is not useful without these characters, since I have been using one without them for a couple of years. In my opinion, the ability to have hard copy, even without these symbols, has been absolutely invaluable. However, I can still appreciate having them.

I began to study the type box (see Photos 3, 4 and 5) on the Model 28 and its printing mechanism. Although I said the five-level machine only has about 54 characters, that was only partially correct. If you figure out how many combinations there are with five data bits, you will come up with 32, which will double if you figure in the shift. So if there are 64 possible combinations, then why is there a difference of ten characters? Well, if you look at the type box in Fig. 1, you will see how the Model 28 type box keys are laid out. The figures and letters shift codes take up four characters – two in lowercase and two in uppercase. The blank takes up two characters, and the space, bell, line feed and carriage return take up one apiece for a total of ten "wasted" characters.

This seemed unnecessary, so I decided to see if anything could be done about it. The clue was that none of these characters positions in the type box contained any type keys, but when the character code was actually decoded by the Teletype it still went through the motion of printing the character even though it was not there. What Teletype had done was to tie these decodes to what they call function levers, which operate certain mechanical functions not related to actually typing a character (e.g., line feed, carriage return, etc.). I decided to give up some of the functions I didn't need to be able to print some extra

```
FF43 70          02420          DEFB    70H         ; O
FF44 6C          02430          DEFB    6CH         ; P
FF45 6E          02440          DEFB    6EH         ; Q
FF46 54          02450          DEFB    54H         ; R
FF47 4A          02460          DEFB    4AH         ; S
FF48 60          02470          DEFB    60H         ; T
FF49 4E          02480          DEFB    4EH         ; U
FF4A 7C          02490          DEFB    7CH         ; V
FF4B 66          02500          DEFB    66H         ; W
FF4C 7A          02510          DEFB    7AH         ; X
FF4D 6A          02520          DEFB    6AH         ; Y
FF4E 62          02530          DEFB    62H         ; Z
FF4F DA          02540          DEFB    0DAH        ; UP-ARROW
FF50 48          02550          DEFB    48H         ; DOWN-ARROW
FF51 48          02560          DEFB    48H         ; LEFT-ARROW
FF52 48          02570          DEFB    48H         ; RIGHT-ARROW
FF53 48          02580          DEFB    48H         ; UNDERLINE
FF54 00          02590          DEFB    0           ; CARRIAGE POS
FF55 F5          02600  ENTRY    PUSH    AF
FF56 326AFF      02610          LD      (CHAR+2),A  ; STORE ASC CHAR
FF59 C6A0        02620          ADD     A,0A0H      ; LEGAL CHAR?
FF5B 3002        02630          JR      NC,START
FF5D F1          02640          POP     AF
FF5E C9          02650          RET
FF5F C5          02660  START    PUSH    BC
FF60 D5          02670          PUSH    DE
FF61 E5          02680          PUSH    HL
FF62 DDE5        02690          LD      IX,ORIGIN   ; LOOKUP TABLE
FF64 DD21F4FE    02700          LD      A,(IX+0)
FF68 DD7E00      02710  CHAR     LD      DE,0F6FEH   ; SHIFT / UNSHIFT
FF6B 11FEF6      02720          LD      C,PORT      ;CHECK FOR SPEC CHAR
FF6E 0E3A        02730          LD      0C8H
FF70 FEC8        02740  PRCENT   CP      NZ,LFCK
FF72 2009        02750          JR      PRTCHR
FF74 CDA4FF      02760          CALL    0,(IX+SHIFT-ORIGIN)
FF77 DDCB6086    02770          RES     ENDALL
FF7B 1864        02780          JR      4AH
FF7D FE4A        02790  LFCK     CP      Z,OUT
FF7F 2850        02800          JR      5BH
FF81 FE5B        02810  CRCK     CP      NZ,PLUS
FF83 2007        02820          JR      A,44H
FF85 3E44        02830          LD      AF
FF87 F5          02840          PUSH    A,50H
FF88 3E50        02850          LD      OUT2
FF8A 184E        02860          JR      40H
FF8C FE40        02870  PLUS     CP      NZ,ASTER
FF8E 200A        02880          JR      PRTCHR      ;SPACE AFTER CHAR
FF90 CDA4FF      02890  SPACIT   CALL    A,48H
FF93 3E48        02900          LD      PRTCHR
FF95 CDA4FF      02910  TYPCHR   CALL    ENDALL
FF98 1847        02920          JR      7EH
FF9A FE7E        02930  ASTER    CP      Z,SPACIT
FF9C 28F2        02940          JR      0F6H
FF9E FEF6        02950  LTHAN    CP      Z,SPACIT
FFA0 28EE        02960          JR      TYPCHR
FFA2 18F1        02970          JR
FFA4 CB7F        02980  PRTCHR   BIT     7,A         ;PRINT CHAR/NEED SHIFT?
FFA6 2040        02990          JR      NZ,SBIT
FFA8 DDCB6046    03000          BIT     0,(IX+SHIFT-ORIGIN)
FFAC 2809        03010          JR      Z,OUTCHR
FFAE DD3560      03020          DEC     (IX+SHIFT-ORIGIN)
FFB1 F5          03030          PUSH    AF
FFB2 7B          03040          LD      A,E
FFB3 CD67FF      03050  OUTCHR   CALL    OUTCHR      ; TWO CHAR OUTPUT
FFB6 F1          03060          POP     AF
FFB7 2E07        03070  OUTCHR   LD      L,7         ; OUTPUT ONE CHAR
FFB9 0F          03080  LOOP     RRCA
FFBA 3009        03090          JR      NC,SPACE
FFBC 26FF        03100  MARK     LD      H,0FFH      ; OUTPUT "ONE"
FFBE ED61        03110          OUT     (C),H
FFC0 CDF5FF      03120          CALL    BITTIM      ; DATA BIT DELAY
FFC3 1807        03130          JR      ENBIT
FFC5 2600        03140  SPACE    LD      H,0         ; OUTPUT "ZERO"
FFC7 ED61        03150          OUT     (C),H
FFC9 CDF5FF      03160          CALL    BITTIM
```

characters that I wanted.

I started with the easiest ones first. The bell was the first to go. On one of my Model 28s, the bell code was tied to the spacing mechanism, which meant that after the character was decoded the carriage would also advance one space. That meant that no extra care would be needed here: however, my other Model 28 did not space after this code, which meant that after I printed my character in this slot I would have to immediately print a space also just to advance the carriage.

Typically, none of these special cases, excepting, of course, the space itself, will automatically advance the carriage after printing the character. You will have to check your individual machine to see if it spaces or not and adjust the program accordingly. If you really know the Model 28, there is a way you can tie these character decodes to the spacing mechanism, but this is certainly not a necessity, since it can easily be programmed around as I will show you.

I also used both upper and lowercase blanks and perhaps the little more obscure uppercase space. Even though the uppercase space did, in fact, space after printing, it had the other side effect of automatically unshifting the carriage after printing, which also had to be programmed around.

The only really clever one was the use of the letters and figures codes themselves. If the carriage is in an unshifted position and the letters code is issued, it is essentially a NOP. This is also true if the figures code is issued and if the carriage is already in a shifted condition.

This would be a necessity if an operator had to type on the Teletype keyboard, since one slip-up would print an unwanted character. However, I considered my TRS-80 to be a nearly perfect typist and would know the condition of the carriage at all times. So I decided that if the carriage was currently unshifted and a letter code was issued, this would mean a character should be printed. If the carriage was in the unshifted condition and a figures code was issued, then I would take that to mean that indeed a shift was intended and as such, only a shift would be done.

A similar discussion would follow in the case of the carriage being in the shifted condition. Of course these, like the other special codes, did not come with an automatic space, so a space must be output after the use of one of these codes to print a character.

After all this work, which was easier than it appeared on the surface, I was able to add six more characters to the basic set. In fact, if you were willing to modify the Teletype mechanically, you could disconnect the function levers from the uppercase carriage return and line feed. This would add two more characters to the character set and bring you up to the theoretical maximum character set for the five-level machine. This would then allow you to print the complete Level II BASIC useful character set.

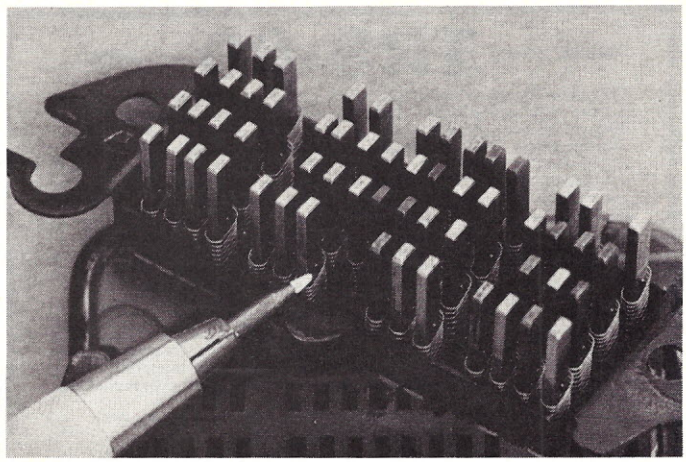

Photo 5. Rear view of type box with cover removed.

```
FFCC 20          03170 ENBIT   DEC    L
FFCD 20EA        03180         JR     NZ,LOOP
FFCF 0602        03190         LD     B,DEL3
FFD1 C5          03200 TIM2    PUSH   BC
FFD2 0622        03210         LD     B,DEL4
FFD4 10FE        03220 DL2     DJNZ   DL2
FFD6 C1          03230         POP    BC
FFD7 10F8        03240         DJNZ   TIM2
FFD9 C9          03250         RET
FFDA CD87FF      03260 OUT2    CALL   OUTCHR    ;OUT 2 CHAR + EXIT
FFDD F1          03270         POP    AF
FFDE CD87FF      03280 OUT     CALL   OUTCHR    ;OUT 1 CHAR + EXIT
FFE1 DDE1        03290 ENDALL  POP    IX        ;CLEANUP + RETURN
FFE3 E1          03300         POP    HL
FFE4 D1          03310         POP    DE
FFE5 C1          03320         POP    BC
FFE6 F1          03330         POP    AF
FFE7 C9          03340         RET
FFE8 DDCB0046    03350 SBIT    BIT    0,(IX+SHIFT-ORIGIN)  ;TTY SHIFTED?
FFEC 20C9        03360         JR     NZ,OUTCHR
FFEE DD3460      03370 SET     INC    (IX+SHIFT-ORIGIN)  ; SHIFT TTY
FFF1 F5          03380         PUSH   AF
FFF2 7A          03390         LD     A,D
FFF3 18EE        03400         JR     DOUCHR
FFF5 060A        03410 BITTIM  LD     B,DEL1   ;BIT TIME DELAY
FFF7 C5          03420 TIM1    PUSH   BC
FFF8 0608        03430         LD     B,DEL2
FFFA 10FE        03440 DL1     DJNZ   DL1
FFFC C1          03450         POP    BC
FFFD 10F8        03460         DJNZ   TIM1
FFFF C9          03470         RET
FE00             03480         END    BEGIN
00000 TOTAL ERRORS

DL1       FFFA
TIM1      FFF7
SET       FFEE
DL2       FFD4
TIM2      FFD1
ENBIT     FFCC
BITTIM    FFF5
MARK      FFBC
SPACE     FFC5
LOOP      FFB9
DOUCHR    FFB3
OUTCHR    FFB7
SBIT      FFE8
LTHAN     FF9E
TYPCHR    FF95
SPACIT    FF90
ASTER     FF9A
OUT2      FFDA
PLUS      FF8C
CRCK      FF81
OUT       FFDE
ENDALL    FFE1
PRICHR    FFA4
LFCK      FF7D
PRCENT    FF70
START     FF5F
CHAR      FF68
SHIFT     FF54
ORIGIN    FEF4
DEL4      0022
DEL3      0002
DEL2      0008
DEL1      000A
PORT      003A
L5        FEEF
ENTRY     FF55
L4        FED5
L3        FEDE
L2        FECE
BEGIN     FEBE
```

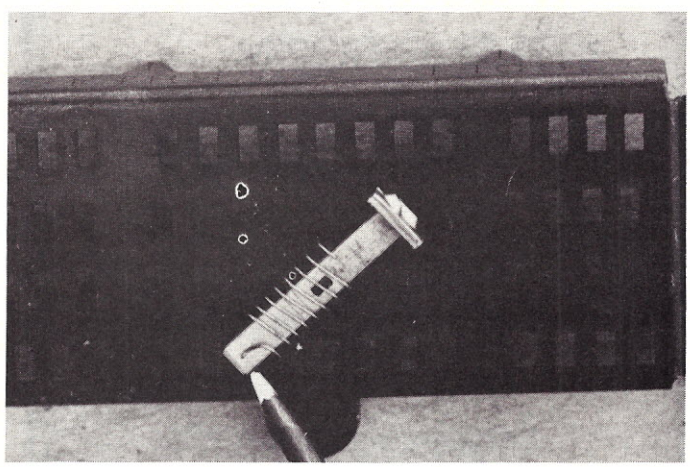

Photo 6. View of pallet and its return spring.

I have not modified my Teletype yet, so I can only choose six characters (out of my desired eight) to add to my character set. Of the eight characters that I previously mentioned were missing, I chose to leave out the @ and ↑. In place of the @, I decided to just output a space, and in place of the ↑, I used !. If you wanted to be a bit tricky, you could have the driver routine print the letters AT each time it was supposed to print an @. These extra type keys (called pallets—see Photo 6) can be obtained from the Teletype service center for about 50 cents apiece.

The modification of the type box is very easy. The type box is held in place by a clip to the right-hand side of the type box as shown in Photo 3. Once the type box has been removed from the Teletype, remove the two bolts on either side of the type box (Photo 4) and remove the back cover (Photo 5). In Photo 6, you will see the hooked end of the spring that is normally inserted into the slot on the pallet as is pointed out in Photo 5. To install a new pallet, insert the pallet with no spring attached into the appropriate hole as shown in Photo 4, then slide the spring over the pallet and push the hooked part of the spring through the hole in the pallet as shown in Photos 5 and 6. Reassemble the type box to complete the modification.

Now that you have seen how I modified the Model 28 type box and how it will work, let's take a brief look at Listing 4 to see how the software has to handle it. Again, the first part of the program should be familiar since it is another copy of the handler routine. The label ORIGIN again defines the beginning of the lookup table, which has been a little better documented in order to help you change the character translation easily. In the first routine, I used blanks (40 hex) as the translation for illegal characters. However, in this routine, I cannot do that since I have made the blank a printable character. So for the illegal characters, I just output a lowercase space, which now is the only character that for sure will not print any character on the paper.

For the most part, the labels in this routine have similar meanings to the labels in the first driver routine. The label PRCENT signifies the beginning of special character checking. A jump to the SPACIT label will print the character and then output a space. This is used after a character that does not automatically advance the carriage is printed. The label ASTER is the check for an asterisk. It is a good example of this need since it is the unshifted letters code, which does not automatically advance the carriage after printing. You can see that as soon as the asterisk is detected a jump is made to the SPACIT label.

This example gives you the tools you need to use any character decode that does not automatically advance the carriage by adding a similar check for that character into the code. A good place to add any additional checks that you might need would be immediately before the ASTER label. For instance, on my Model 28, the uppercase blank (now a >) and the bell both advanced the carriage automatically so I didn't need to do any checking for them. However, it is possible that your Teletype may not advance the carriage automatically. In that case, you would need to add two checks for these decodes immediately before the ASTER label.

Although the first driver routine was relocatable anywhere in memory, this one is not. In order to move this one around, you must assemble it at the desired location.

After you understand how the program works, you can logically extend this knowledge to develop an even simpler program to communicate with other Teletype machines (e.g., the ASR-33 Teletype). Most of the other Teletypes are ASCII, which means that no lookup table is required, and which additionally means that no shifting is required to print any of the characters. ■

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Lakeside MT 59922

When putting together my first micro, I was greatly confused by the available I/O choices. I remember wondering, for example, why some terminals were self-contained, while others used separate keyboards and video boards and why some were serial and others parallel.

Being familiar with Teletype practices, I finally chose what is commonly referred to as a "glass Teletype," or, more impolitely, a "dumb terminal." Interfacing this device required plugging a separate I/O board into the S-100 bus. I soon learned that computer I/O can be frightening in any form, largely because I chose the Imsai MIO with its now infamous documentation. In retrospect, however, I have to admit that it has good hardware.

Although serving well for business use, such an arrangement does not fully exploit the available technology for such uses as graphics and text-processing; hence, sooner or later, I felt it necessary to go the route of completely separate video processing, via a board internal to the micro itself and some slightly sophisticated software to permit on-screen editing, among other features. I had long wanted lowercase characters, too, and the 8×10 matrix of Ithaca's product even permitted descenders on those letters needing tails.

Choosing a Video Board

We hobbyists are sometimes accused of being frugal. Having had good results with Ithaca Intersystems' low-priced memory kits, I chose their video board largely on the basis of price.

One of Ithaca Intersystems' greatest selling points is their willingness to sell the bare board and documentation for a reasonable cost, so that the builder may use his own surplus parts to populate the kit or buy them wherever he feels the deal is best. This can result in reasonably priced hardware if you have access to free or inexpensive spare parts. (Ithaca's video boards and memory board go for $25 each, with full documentation.) If you wish, you can also purchase the fully assembled video board for $145.

One look at this board indicates that Ithaca Intersystems is a company whose already good products have improved with time. A few years ago their boards could be described as good enough for the price; now the engineering and the board itself appear to be of the highest quality. And after $3000 worth of S-100 components, with their usually inadequate and/or erroneous documentation, this one was a pleasant surprise.

In addition to clear descriptions of the circuitry and easy-to-read diagrams, there was a request for comments and suggestions from the user. Unfortunately, I did have to be a little bit critical. There were a few errors, such as disparities between the diagram and parts lists. Most builders could make an intelligent guess on these.

Missing was any description of actually using the board. And the otherwise outstanding software furnished used some labels and some absolute addresses, posing a slight reassembly problem for anyone not proficient at such chores.

Evaluating computer components is subjective and often depends on what the buyer is already using. For example, some video boards provide a parallel keyboard port on the board itself; this one does not. This is of little importance to me, since I have a separate keyboard/terminal and I/O board already incorporated in my system, but it could influence the decision of someone starting from scratch to assemble a system. The point is that any such system requires data to be input and data to be output. These are really separate functions, even though they are often combined for hardware purposes.

As purchased from Ithaca Intersystems for $25, the kit consists of the blank, etched and labeled board, the assembly instructions, a few debugging suggestions and the necessary software. If you carelessly buy good-quality parts, you might spend another $100 to complete the project. More realistically, the total cost for the project, over and above the initial $25, is $75, which was my total cost for the board and everything else I had to purchase.

The kit instructions advise

the builder to omit heat sinks on the two 7805 voltage regulators. I used them anyway, but, with low-power chips, they are not really necessary. Total drain from the user's supply is between 1/2 and 1 Amp.

Another hardware subject to note (not just for this, but for any S-100 project) is the bus signals actually used or generated by the new item. Most of us have run into this sort of compatibility problem at some time. This one should be compatible with almost anything, but it does require the read and write signals, In, Out, Dbin, clock phase 2 and Sync. It also must access all address lines, the data in and data out lines, both the ± 16 volt supplies and the 8 volt supply.

The board gets its input from the bus; the output to your TV or monitor is via a small coax cable. This output consists of the characters plus the horizontal and vertical sync signals. A worthwhile mod the user can make is to put a miniature connector at one corner of the board to facilitate this connection.

Use of the Board and Software Driver

For those not familiar with such projects, the arrangement consists of 1K of memory on the board, which is addressed somewhere above the "real" memory. Ithaca Intersystems indicates this can be located almost anywhere. Actually, some software, such as most versions of Electric Pencil, require the video display to be at CC00H, and the driver also assumes this. Such references must, of course, be changed if addressed anywhere else.

Software is really the key to what can be accomplished with a device like this. Features include the ability to back up the cursor and thus erase a mistake and control the speed of the scrolling action. The CPU and main memory are also communicated with so that actions by either the board system or the rest of the system will agree.

This particular board, like many others, also lets the user select a white-on-black or black-on-white display. It also enables you to use more exotic software that requires memory-mapped video. Electric Pencil is one of the best known of these.

When first fired up, this board wants to see a form-feed (control L) as the first character. This is necessary to clear the screen of the pretty, random display of any printable or, for that matter, unprintable characters that are in memory. Unprintables are not X-rated—they are the ASCII representation of spaces and carriage returns, for example. Your driver must supply this initialization routine.

As is often the case, it also wants this character, and all succeeding ones, in the A register. Most operating systems pass this from some other register just prior to printing. North Star likes B, and CP/M likes C. I am not familiar with any other specific systems.

In addition to clearing the screen, the initialization sets the bounds of the top and bottom line and sets up the scrolling arrangement. After this, output can be more or less normally handled, and the video and CPU will remain on good terms.

How It Works

Characters are placed in the appropriate memory cell representing the particular spot on the screen where the character will appear. The cursor can also be caused to appear anywhere and occupies the entire rectangle representing that space; however, there is no conflict between cursor and character.

If you have selected black letters on a white background, the cursor block will also be black; however, the letter that may happen to be hiding beneath the cursor is, at that time, reversed and appears as a white letter outlined against the black cursor. Hence, no display is ever obliterated by the cursor, even though it is a solid block.

It happens like this: The character generator chip is simply a ROM with the ASCII code for each character programmed into it; calling any address within it returns the necessary dot pattern to paint the desired character on the screen. The ASCII pattern uses only the lower bits, and bit seven is reserved for the cursor; hence, any screen location can contain, at the same time, both the cursor and a character. Needless to say, the timing among the dot generator, screen sweep signals and character is critical. For this reason, all timing is derived from an on-board crystal oscillator.

Most of the needed parts can be found in computer stores or radio parts houses. There are a few exceptions. Two or three of the chips, such as the character generator, are more or less uncommon. If you cannot locate one readily, Ithaca Intersystems sells them, as well as the dot generator crystal and the single resistor pack. (You can as easily use half a dozen resistors as the pack, but it looks nicer.) Two other not-so-common items are the trimpots used to adjust the centering of the video display on the monitor.

The hardware is fairly simple in view of the construction notes provided with the kit. Checkout is feasible with nothing more than a VOM and a logic probe, unless there are serious timing problems, in which case you send it back to Ithaca for help. My recommendation is to add it to the existing system, if there is one, without attempting to actually use it.

It should be possible, if it is all there, to use your FILL or POKE commands, depending on your version of BASIC (or even panel switches) to place ASCII characters in the memory cells within the bounds of the video board (i.e., 52 to 53K, if that is where you put it). They should then display on the screen. If not, some troubleshooting is in order.

If this can be accomplished, there is nothing left to do but write the software. Not meaning to frighten anyone, this is best done with the help of someone who has an assembler and/or is familiar with assembly-language programming. It will actually work right if entered exactly as it is, provided you are using all the same addresses.

The software driver furnished with the kit runs to over 200 bytes. Squeezing it into your own system might pose a problem, as there must still be room for your input and initialization procedures. North Star, for example, allows the user 250 bytes for this purpose. CP/M has twice that, and other systems, no doubt, vary.

I chose to relocate my printer driver as a separate file for use with North Star. This is not necessary with a larger user area such as that provided by CP/M. Some pruning could be done to save space, but each portion removed could disable some desirable feature.

The attractive thing about such a system, when installed intact, is that it permits the continuous checking for various control characters that enable the additional user control and flexibility.

Summary

This board represents an excellent buy for people wanting to include a video display in their repertoire. Neither the hardware nor associated software is especially difficult, although a beginner would be well advised to have some initial help with them. It also helps to have some other operating system already in existence, as an aid to the debugging that may be needed.

Ithaca Intersystems is ready to help, as witnessed by their request for comments and their offer, in the documentation, to fix any board that is beyond the test-equipment capability of the builder. All video boards are limited in their display to some fixed number of lines on the screen and number of characters per line (24 by 80 is considered a nice size). The Ithaca Intersystems board, along with many on the market, has 16 lines by 64 columns. It's simply a case of getting what you can afford to pay for. If a 16-line display is all you really need, by all means try this one. ■

Route 66 Modem

A modem links your microcomputer to anyplace that has a telephone. Get on the road to high adventure with this economical design.

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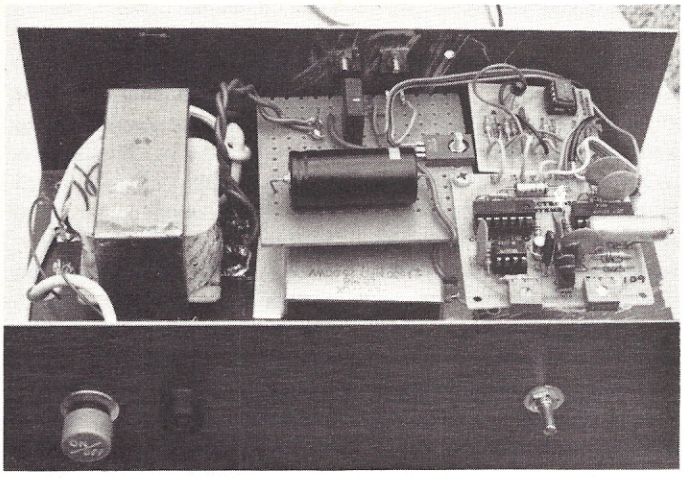
Back in the innocent(?) early 60s, almost every high-school-age male in the Middle West had the "Route 66" fantasy. We dreamed of rolling off down Route 66 in a fast Corvette in search of romance, adventure and knowledge.

Well, today we aren't even taking any long trips, let alone fast ones. But we can still extend ourselves into the world in search of knowledge, adventure and maybe even romance. We can extend our computer selves through the use of a modem and the regular telephone lines. The price of the modem I will describe adds up to $66 if you pay full retail. Therefore, I call it the Route 66 modem.

Commercial modems are expensive. When you consider what they do and the price of the parts, the typical $200+ price tag is pretty steep. Perhaps the gravy in the simple modems is paying for the R&D of the exotic high-speed error detection and correction units, but I don't want to pay the tariff for a simple audio-to-dc converter.

My answer is to send an order off to a company called Electronic Systems, which usually has an ad in the back of *Microcomputing*, for a $27.50 modem kit. The modem has a TTL output, but they also have an inexpensive TTL/RS-232 board, so it will interface to most terminals or computers. A power supply and enclosure are needed to complete the package. Access to a frequency counter and audio oscillator is almost a must for alignment.

I chose to get the cabinet and power supply parts from Radio Shack because they were handy. If you order from some of the parts houses advertising in the back of the magazine, you may be able to put the originate-only modem together for under $50.



The layout of the modem is not critical. The operating controls are simple. The switch on the panel selects either the answer or originate modem board.

Theory

A modem is a communications device. It takes the output from your computer or terminal (usually a ±12 volt signaling scheme called RS-232) and converts it into audio tones that can be passed over the phone lines. Another modem is at the other end of the phone line.

The second modem converts the tones back into dc, which it feeds into its computer or terminal. This means that you can (theoretically) talk to and exchange programs with people with other brands of systems than the one you own.

For example, an OSI Challenger and a TRS-80 may both be using simliar Microsoft BASIC, but that doesn't mean they can swap programs on cassettes. The cassette systems are different. But if they both use a common RS-232 ASCII format, they can exchange information over a telephone or wireline. It is more complex than that because they should have some way to save what they receive, but there are software routines available to do this already.

Originate and Answer

If the modems at either end of the line are both pumping out tones at the same time, then it becomes obvious that they can't both use the same tones, or they will hear only themselves. Four tones are needed so that the high and low dc pulses can be converted into separate high and low tones at each end.

Several standards exist for what tones will be used, but the most common is the Bell 103. This standard says that the modem that is on the terminal end (in a time-sharing system, for instance) will use 2225 and 2025 Hz for transmit. This is called the "originate" modem. The modem on the computer end of a time-sharing system (the "answer" modem) transmits at 1270 and 1070 Hz.

Many hobby computer users have been unpleasantly surprised when they have bought or built low-priced modems that were originate only. Two originate modems cannot talk to each other. Most kits that advertise "originate or answer" (including the Electronic Systems kit used here) must be hard-wired in either configuration. It is hardly a convenient

way to do it, but by using two of the kits with a common power supply and other parts, we can have both capabilities at a low price.

The Kits

Electronic Systems will take credit-card orders when the phone rates are low. My order was shipped the next day. Both kits (shown in the parts list) were complete with sockets for the ICs. Construction required just stuffing the parts into the holes and soldering.

The 2N2222 transistor supplied with the TTL/RS-232 kit had a round case without a tab, so I had to use a VOM to find out which leads were the emitter/base junction. I felt that this assumed a sophistication on the part of the builder which might not be present. The modem kit had a properly marked 2N2222. The markings on the little Mylar capacitors rub off quickly, so don't touch their flat sides or you will have a pretty puzzle to work out.

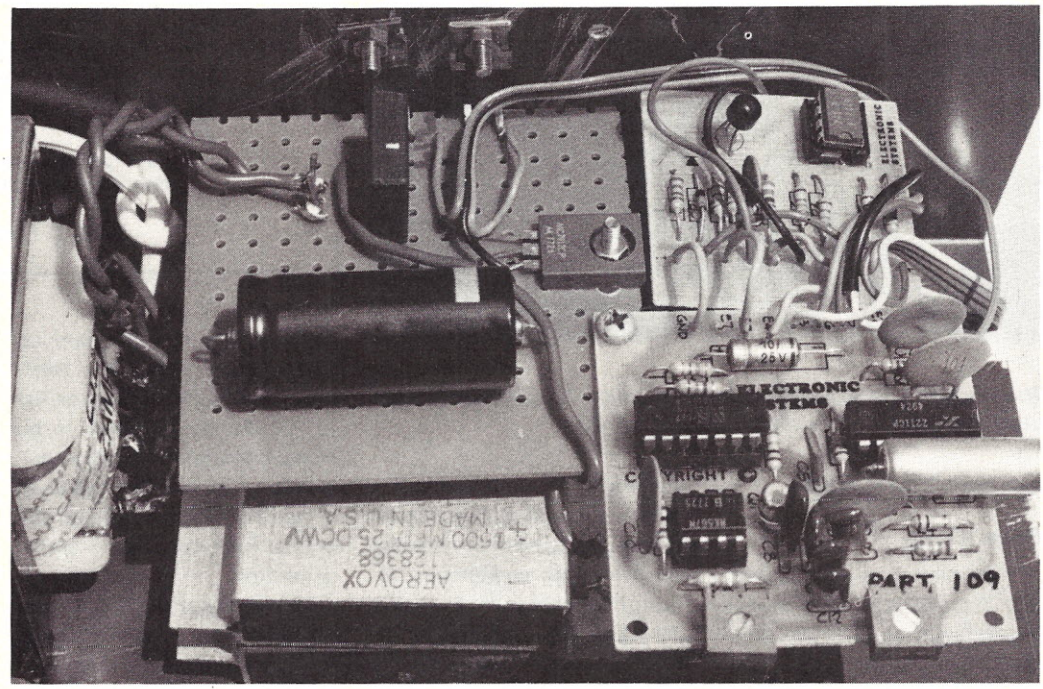
The modem kit came with excellent documentation that described the operation of both the transmit and receive sides. Select the proper components for either originate or answer. Stuffing and soldering the kit boards is about a two hour job, if you take time out to read the directions.

Phone Line Connection

The modem kit calls for a high-impedance input such as a crystal mike and a low-impedance output such as a speaker. This could be provided in several ways. First, you could spend a few dollars for a crystal mike and a speaker and build them into a stand that would hold a telephone handset.

Second, you could buy an audio pick-up such as the one advertised by the Rondure Company for $17.50. Third, you could, as I did, find an old amateur-radio phone patch and use it to couple into the phone line. Finally, you could buy two 99 cent transformers and couple into the phone line that way (as shown in Fig. 1).

A word of note: If you direct-couple into the phone line with a phone patch or the transformer system, you will be required to get the phone company to install something called a direct access arrangement (DAA), which stops unwanted tones from going down the phone lines and fouling up the telephone company's switching systems.



The modem board is lower right with the TTL/RS-232 board above it. The power-supply components are mounted on the board on the left. The two positive voltage regulators are on the chassis wall. The negative regulator must be insulated from the chassis. The two modem boards are stacked on top of each other. The modems are grounded through their mounting screws.

Interfacing

The output of the modem board is transistor-transistor logic (TTL), which is a system of signaling using +5 and 0 volts. Some terminals can use TTL levels. If you have one of these, then you don't need the TTL/RS-232 board. (See "Parallel Port to RS-232," April 1979 *Microcomputing*.)

Electronic Systems also has a TTL/20 mA current loop board, so if you are using a terminal such as a Model 33 you can use this interface. The majority of terminals and computers use an RS-232 interface.

When you make up the connecting cable, you must decide if you are going to plug into a computer or a terminal. This is important for several reasons. First, a computer has a female RS-232 jack mounted on its chassis; a terminal has a male. Second, the standard is set up so that a computer expects to receive data (from terminal 5 of the RS-232 board) on its pin 2 and to transmit data (to terminal 2 on the board) on its pin 3. A terminal outputs on 2 and receives on 3 so that it mates with a computer.

As the modem builder, you have to decide which device you need to mate to. If you want flexibility, then simply prepare two different cables that plug into a jack on the modem. In either case, pins 4 and 5 of the DB25 plug should be wired together so the device provides its

Modem kit: Electronic Systems Part No. 109A
TTL/RS-232 Converter: Electronic Systems RS-232
DB25P Plug: Available from Jameco Electronics or with an 8 conductor cable from Electronic Systems, PO Box 21638, San Jose CA 95151.

Item	Radio Shack Part No.
Neon panel light	272-705
Aluminum cabinet (3.5 × 9 × 6)	272-261
VR1 +5 volt regulator (7805)	276-1770
VR2 +12 volt regulator (7812)	276-1771
VR3 −12 volt regulator (7912)	NOT LISTED
D1 4 AMP 50 V bridge	276-1146
C1, C2 2200 uFd capacitor	272-1020
S1 SPST switch	275-011
Ac power cord	278-1255
T1 transformer 25.2CT 2 Amp	273-1512

Parts List.

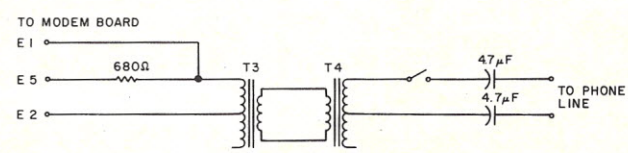
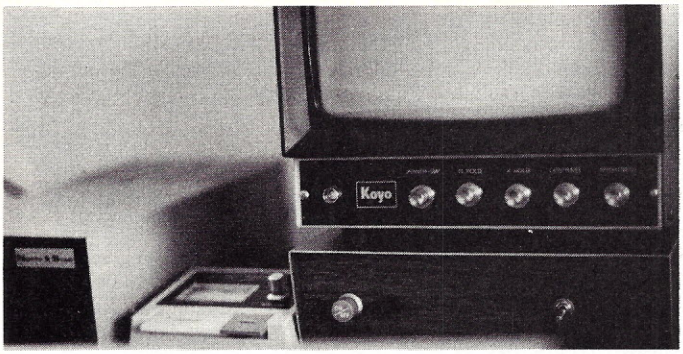


Fig. 1. This circuit can be used to connect the modem board to the phone line. T3 and T4 are two identical Radio Shack audio output transformers (stock no. 273-1380) with their secondaries hooked together. The capacitors keep any stray dc voltages out of the transformer.



The modem tucks in neatly under the monitor. The old phone patch used to couple into the phone line is on the left.

own clear-to-send signal.

Power Supply

The power supply I've shown (Fig. 2) provides all the voltages needed with an absolute minimum of parts. The bridge rectifier isn't working as a bridge; it is working as two separate full-wave rectifiers in one convenient package—one for +12 and one for −12 volts. The +5 volts is tapped from the +12 volt source. The −12 volt regulator isn't a standard item in the Radio Shack catalog, but many stores now carry them.

The photographs show the general layout I used. I just mounted everything on a piece of perforated board and used point-to-point wiring underneath. The components run cool and can handle two modem boards with no problem.

Double Talk

If you only use one modem board, then you will have either an answer or originate capability. If you know exactly who you are going to talk to, this may be enough. But to be truly versatile, you need both capabilities. Although Electronic Systems gives you the right parts for either format, there are too many connections and alignments involved for easy switching.

The best way is to buy two modem boards, set one up for answer and one for originate, connect the audio and power-supply lines to both in parallel and switch the TTL input and output lines between the two modem boards with a simple DPDT switch. Doing it is easier than writing about it, and the diagram for the switching is Fig. 3.

Alignment

If you have a friend with a modem and a lot of patience, it is possible to align this system by slowly turning the trimpots until you are sending and receiving good copy. The only adjustment consists of one pot each for the transmit and receive frequencies. The tolerance is about 10 percent or 100 to 200 Hz, so you have to be close. A frequency counter really helps. I used a shortwave receiver with a beat note on the crystal calibrator for a signal generator.

These modems are not crystal controlled, so try to set the unit up under fairly standard temperature conditions. Some drifting with age may take place. The only problems I have are with some other 300 baud modems on the end of some phone lines on some days. It isn't consistent. Usually, switching down to 110 baud improves the reliability of communications.

Tone	Logic	TTL Level	RS-232	TTY State
2225 Hz	One	+5	−12	Mark
2025 Hz	Zero	0	+12	Space
1270 Hz	One	+5	−12	Mark
1070 Hz	Zero	0	+12	Space

(1270 and 1070 are received by an originate modem)
(2225 and 2025 are received by an answer modem)

Table 1. Tone/level table.

What Do You Say After Hello?

Now that you can get information into your machine, what can you do with it? If you are using a terminal, you might print it out on an attached printer. But many of us want to use our computers to communicate and then to manipulate what we received.

In the easiest form, you can stay in BASIC while someone at the other end talks to you in the form of line numbers and REM statements that will keep BASIC from issuing error messages. You can then save the text and programs you received in your normal way. That is probably good enough to converse with your friends, but don't expect a time-sharing system to talk to you in REM statements. You could write a BASIC program to allow free-flow discussion, but you would need a files capability to save what you got. This is not available on most cassette systems.

Radio Shack is advertising a communications software package for the TRS-80 under catalog number 26-1146. Jim Dvorak (see "Who Sells Software?" April 1979 *Microcomputing*, p. 48) has recently been advertising a useful program for North Star users. With a program that will allow you to talk in plain text "terminal mode" to a larger computer and then to save whatever you receive, you can literally suck the larger systems dry of interesting programs that they will let you list.

One minor operating point: When your modem is not receiving a signal, it will sit at rest in either the logic zero (space) or the logic one (mark) state (see Table 1). If it comes to rest on a logic zero, it will drive your computer frantic. If you are operating with a time-share system as an originate modem, don't turn your modem on until you hear the other system first. Then act promptly or you might time out.

If you are serving as an answer modem for someone who has a commercial originate modem, you may have to give him a tone first so that it opens his transmit line. In this case you might get some garble until your modem is in synch. That is a small price to pay for the capability to send and receive computer-to-computer information.■

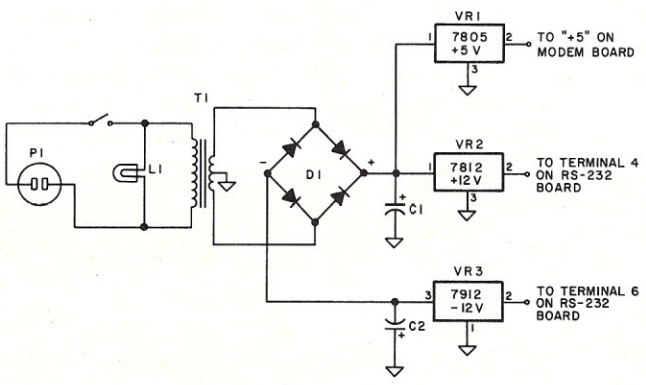


Fig. 2. This power supply is simple and effective. The bridge is being used as two full-wave rectifiers. Note that the pins are different on the negative regulator and that it must be insulated from the chassis.

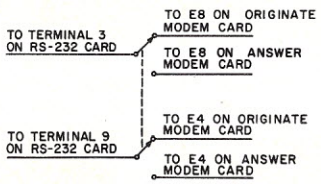


Fig. 3. If the you need both an answer and originate modem, a simple DPDT switch will allow you to switch the TTL inputs and outputs from either modem board into the TTL/RS-232 board. The power and audio leads are hooked to both boards in parallel.

Thoughts on the SWTP Computer System

Installment number 8 of this series looks at the new 6809 microprocessor.

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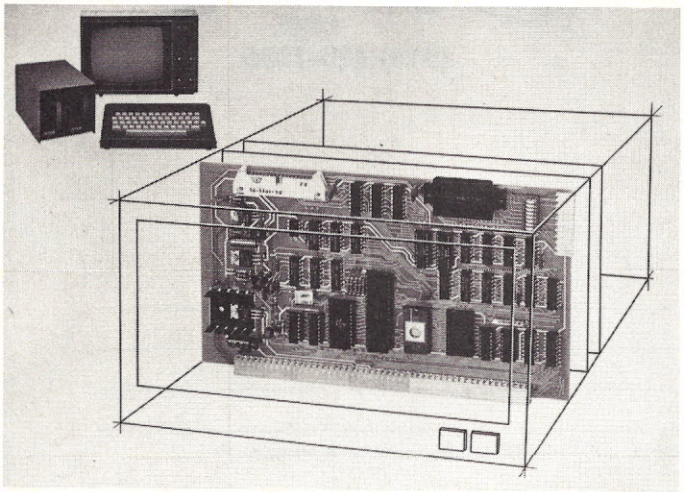
The king is dead; long live the king!" So goes an old saying that may be apropos right now. "The 6800 is dead; long live the 6809!"

Motorola's 6800 isn't dead, of course, but SWTP's 6800 is. SWTP has apparently discontinued all manufacture and sale of their 6800 computer, and is concentrating completely on their new 6809-based system. I say "apparently" because it is not entirely certain just how complete this move is. Will SWTP continue to support 6800 systems? Will they continue to sell bare boards or board kits? Will their disk systems continue in their present form, or will they, too, be revamped for the 6809? Only time will tell.

The only thing certain right now is that complete SWTP 6800 computers are no longer available. 6809 systems are available, but without — as yet — much supporting software.

As has been evident for some time, SWTP marketing strategy has changed over the past year or two. A 6809 kit will be available (for $495 with 8K of memory), but the initial push is for assembled systems, mostly with a lot of memory. SWTP (along with many other manufacturers) is aiming for the "business" market.

In a way, this may be a boon to SWTP competitors. Especially in the industrial market, 6800 demand will probably continue, and now that mainframes, cards, disk systems and all the other equipment are available from other manufacturers, that will be all that's sold. Unfortunately, none of these can offer the price/performance ratio that SWTP always has offered.



The SBC/9 board for the 6809-based computer system. (Photo courtesy of Percom)

The Motorola 6809 Microprocessor

The 6809 is like a wolf in sheep's clothing. Internally, it is like a 16-bit processor; externally, it resembles an 8-bit processor such as the 6800. For this reason, it is hardware-compatible with older 6800 systems — so that with the addition of a new CPU board, older SWTP systems can use the 6809 — yet it can do software tricks not possible before.

It is a vast improvement over the 6800 in many ways, though not as compatible with it as generally thought. (It's not like the Z-80 being able to run 8080 programs. 6800 programs must be modified for new instructions; a few 6800 instructions that do not exist in the 6809 must be programmed around.)

The 6809 has two accumulators, but they can be used together as a 16-bit accumulator. It has two index registers and two stack pointers. It can perform 16-bit addition and subtraction and 8-bit multiplication. It can push and pull other registers, besides the accumulators, and has a variety of addressing modes that can greatly speed up and shorten programs. Some of the 6800's addressing modes are more versatile with the 6809 — direct addressing can be done throughout memory, not just in lower memory. Conditional branches can go anywhere, not just 128 bytes (more or less) forward or back.

Other addressing modes are new. For instance, there are indirect modes that allow handling data without loading the index register with a base address first. PC-relative addressing adds an offset or displacement to the address in the program counter, in much the same way as indexed addressing adds an offset to the contents of the index register. This allows writing completely relocatable programs without

some of the tricks needed to do the same on the 6800.

In terms of hardware, the 6809 is available in two versions: the MC6809 with a built-in clock oscillator, which requires only an external clock to set clock speed, and the MC6809E with external clock inputs. The MC6809 with the built-in clock and a 4 MHz crystal operates at a 1 MHz clock speed to match older systems. An 8 MHz crystal (with the MC68B09 version of the processor) operates at the higher 2 MHz clock speed; but this is not compatible with SWTP 16K and 32K memory boards and may not work with smaller boards either unless the memory chips are also replaced. (16K and 32K memory boards can apparently not be upgraded to work at the higher speed, due to the way the dynamic memory refreshing is done.)

SWTP also states in their 6809 CPU board instructions that the 6800 and 6809 mainframes may not work reliably above 1 MHz.

6809 pin signals are a bit different from those of the 6800. Bus control signals, designed for allowing other devices to share the bus with the processor, are different. Since the 6809 has a built-in clock oscillator, there is a clock output rather than clock inputs. The clock output is now called the E, or Enable, signal, instead of Ø2. This better matches the E inputs that the PIA and ACIA chips have had for years. There is even a second clock output, now called the Q output. On the other hand, VMA (valid memory address) is now gone.

A third interrupt input, FIRQ (fast interrupt), has been added for really fast response. And an M.RDY (memory ready) input makes the processor wait for slow memory. (Shades of S-100 systems!)

When a program is rewritten to take advantage of the 6809's features, it can run a lot faster than on a 6800. But when it is just doctored up a little — by reassembling, for instance — then it runs somewhat faster, but not by much . . . not enough to justify the effort, anyway.

The new SWTP 6809 computer has a completely redesigned cabinet, and so looks like a completely new unit. Inside, though, there are some marked similarities.

SWTP 6809 System

The new SWTP 6809 computer has a completely redesigned cabinet, and so looks like a completely new unit. Inside, though, there are some marked similarities. There's still a motherboard with separate 50-pin connectors for CPU and memory and 30-pin connectors for I/O. There's still address decoding on the motherboard and a beefed-up power supply.

But there are some changes too. Some, such as the new I/O addressing on the motherboard, are minor. Others, such as the design of the CPU board and the monitor, are major. In fact, the CPU board — called the MP-09 (available for $175 as a modification to present systems) — tells the whole story of the system.

In addition to the 6809, the MP-09 board has sockets for memory. But unlike the 6800 CPU boards, the MP-09 does not use an MC-6830 mask-programmed ROM monitor and does not have the 6810 128-byte scratchpad RAM of the earlier CPU boards. Instead, it has four sockets that are for single-supply 2716-compatible EPROM, ROM or RAM (like the MP-A2 CPU board). The new SWTP 6809 monitor is called SBUG-E and takes up 2K, or one socket. That leaves three more.

Those sockets can be used for 2716 2K × 8 EPROMs; they can also be used for other pin-compatible devices. SBUG-E comes on a mask-programmed ROM that fits those sockets; other ROMs may be available later, or large users may be able to supply their own. Several manufacturers have also announced 2716-compatible RAMs, which are not yet available. Thus, the CPU board has room for up to 8K of memory in any combination of ROM, EPROM and RAM.

The four memory sockets are addressed as follows:

IC1—E000-E7FF
IC2—E800-EFFF
IC3—F000-F7FF
IC4—F800-FFFF (used for SBUG-E)

IC4, which is normally used for the monitor, is always enabled; the other three sockets have DIP switches that allow them to be either enabled or disabled and determine whether they are used for ROM or RAM (by controlling one of the pin connections).

But here's the rub. IC1 through IC3 are not usable with the SBUG-E monitor in a full-fledged 6809 system, because I/O in an expanded system will be moved up into the same memory region as these sockets occupy. The extra three sockets are intended for dedicated applications (industrial control, for instance), where a custom monitor — other than SBUG-E and one that would use other addresses for I/O — would be used. So these sockets (unlike the 2716 sockets on an MP-A2 6800 board) can generally not be used for extra software.

The addressing for these memory sockets is more thorough than monitor addressing in older 6800 systems. Monitor and high memory addresses are fully decoded, so that extra addresses are not used up in vain. This was a big problem with the 6800 system, which dated back to days when memory was so expensive that nobody ever thought a hobbyist or small user could afford more than 32K.

The MP-09 board also has a 14411 baud rate generator; but whereas 6800 systems only generated baud rate signals for 110 through 9600 baud, the MP-09 can generate signals for as much as 38,400 baud. Since there are only five baud rate lines on the motherboard, a DIP switch and several jumpers are used on the CPU board to determine the exact baud rate signals that exit the CPU board to the bus. (Read on. In some cases, this baud rate generator may have to be disabled.)

Now to the differences. First of all, the MP-09 has improved facilities for releasing all buses during DMA transfers or in multiprocessor systems. This is in line with some of the 6809 features, which are designed for such advanced applications. This includes the familiar BA (bus available) line and some new signals. BS (bus status) replaces the old Ø1 signal, and BUS REQ (bus request) can be strapped on the 110-baud line instead of the baud rate signal. These two signals are used to tell other boards (not yet developed) what the 6809 is doing.

Since existing boards need a VMA signal, but the 6809 doesn't provide it, the MP-09 manufactures a VMA whenever the 6809 indicates that the bus is being used and is not available for other use.

The MP-09 also connects some of the other new 6809 signals such as BS, clock (Q and E), M.RDY, BUS REQ and FIRQ to the 50-pin bus on the motherboard.

However, the SS-50 bus only started out with two extra unused lines, called UD (user defined) 1 and 2. Where did all the new signals go? Back in 1978, there were several

Pin no. (from left to right)	Old SS-50 signal	New SS-50C signal
1	1200 baud	1200 baud or S0
2	600 baud	600/4800 baud or S1
3	300 baud	300 baud or S2
4	150 baud	150/9600 or S3
5	110 baud	110 baud or BUS REQ'
6	HALT'	HALT'
7	Ø1	BS
8	BA	BA
9	RESET'	RESET'
10	R/W'	R/W'
11	VMA'	VMA'
12	Ø2	E
13	UD1	Q'
14	UD2	FIRQ'
15	IRQ'	IRQ'
16	NMI'	BUSY'
17	M.RST'	M.RDY
18	-	-
19	+12 VOLTS	+16 VOLTS
20	−12 VOLTS	−16 VOLTS
21-23	+8 VOLTS	+8 VOLTS
24-26	GROUND	GROUND
27-42	A0 through A15	A0 through A15
43-50	D7' through D0'	D7' through D0'

Table 1. Old and new 50-pin buses.

Pin no. (from front to back)	Old SS-30 signal	New SS-30C signal
1	I/O PORT SELECT'	I/O PORT SELECT'
2	RESET'	RESET'
3	110 baud	110 baud
4	150 baud	150 or 9600 baud
5	300 baud	300 baud
6	600 baud	600 or 4800 baud
7	1200 baud	1200 baud
8-9	+8 VOLTS	+8 VOLTS
10	R/W'	R/W'
11	Ø2	E'
12-19	D7 through D0	D7 through D0
20	RS1	RS1
21	RS2	RS2
22	IRQ'	IRQ'
23	NMI'	FIRQ'
24	-	-
25-26	GROUND	GROUND
27	+12 VOLTS	+16 VOLTS
28	−12 VOLTS	−16 VOLTS
29	UD4	RS3
30	UD3	RS2

Table 2. Old and new 30-pin buses.

meetings of 6800 manufacturers to hammer out what the standard SS-50 bus should be and what, if any, modifications should be made to it in the future. At that time, there was a consensus on three possible versions of the bus: SS-50A, SS-50B and SS-50C. SWTP is now using a slightly modified SS-50C bus in their 6809 system. Table 1 shows exactly what lines are used on the old and new bus. In the same way, Table 2 shows the changes to the 30-pin I/O bus.

We've already described some of the SS-50C changes. Let's now look at the others.

On the 50-pin bus, pins 16 and 17 were NMI' and M.RST' on the old bus. What happened to them? They are still on the MP-09 CPU board, but they are brought to connectors at the top of the board. M.RST (master reset) now must be wired through a short cable to the RESET switch on the front panel. Likewise, NMI' must now be wired through a separate cable. In noisy environments, shielded cable may be needed.

The 12-volt supplies have been replaced with 16-volt supplies. As was described in the first installment of this series ("Some Thoughts on the SWTP Computer System," March 1979, p. 58), these supplies have always been marginal, and changing from 12 volts to 16 should improve things. But watch out! Some add-on boards requiring 12 volts have, in the past, been designed without on-board regulators, relying on the 12-volt supplies' proximity to the required values. To use them in a new system, you will have to install the missing regulators, or risk serious damage to them.

The 50-pin bus also shows another change in pins 1 through 4; four of the baud rate signals can be replaced with signals S0 through S4, four additional address lines that allow the system to be expanded up to an advertised 384K of memory . . . and perhaps more.

MP-09 Addressing Circuitry

The big change, which affects the whole system and may make it impossible to switch back and forth between the 6800 CPU board and a new 6809 CPU board, is in addressing. The MP-09 CPU board, combined with the SBUG monitor, has an interesting combination of hardware and software for memory and I/O addressing.

The MP-09 board has sockets for two 74LS189 16 × 8 TTL RAMs: One of these (IC11), called the DAT (dynamic address translator), is required; the other (IC8) is optional, to be used for extended addressing.

Dynamic Address Translator

The address translator is of immediate interest. It is basically a 16 × 4 RAM, which is addressed as locations FFF0 through FFFF. You may note that this overlaps the monitor, which is FC00-FFFF. But the difference is that the monitor is a read-only memory, whereas the RAM is write-only memory. The two do not conflict, even though they share the same address, since a read and a write can never occur at the same time. When a load is executed from FFFF, for instance, only the ROM is affected. When a store is executed to FFFF, only the RAM is affected. Since this RAM only stores four bits, only the rightmost four bits of the number being stored into FFF0-FFFF actually get stored in the DAT RAM.

Fig. 1 shows a simplified diagram of the DAT. The address inputs into the RAM are connected to the address bus through a 74157 selector, IC10. IC10 acts as a two-position switch, connecting either its four A inputs or its four B inputs to the RAM.

When the RAM is being written into, the selector is switched to the B inputs. The rightmost four bits of the address—shown as A3 through A0 at the bottom of the diagram—are fed through the selector to the RAM. Since

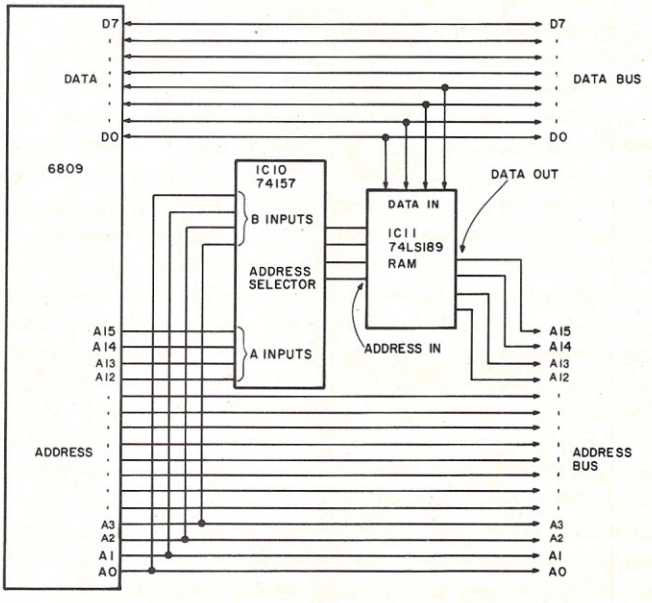
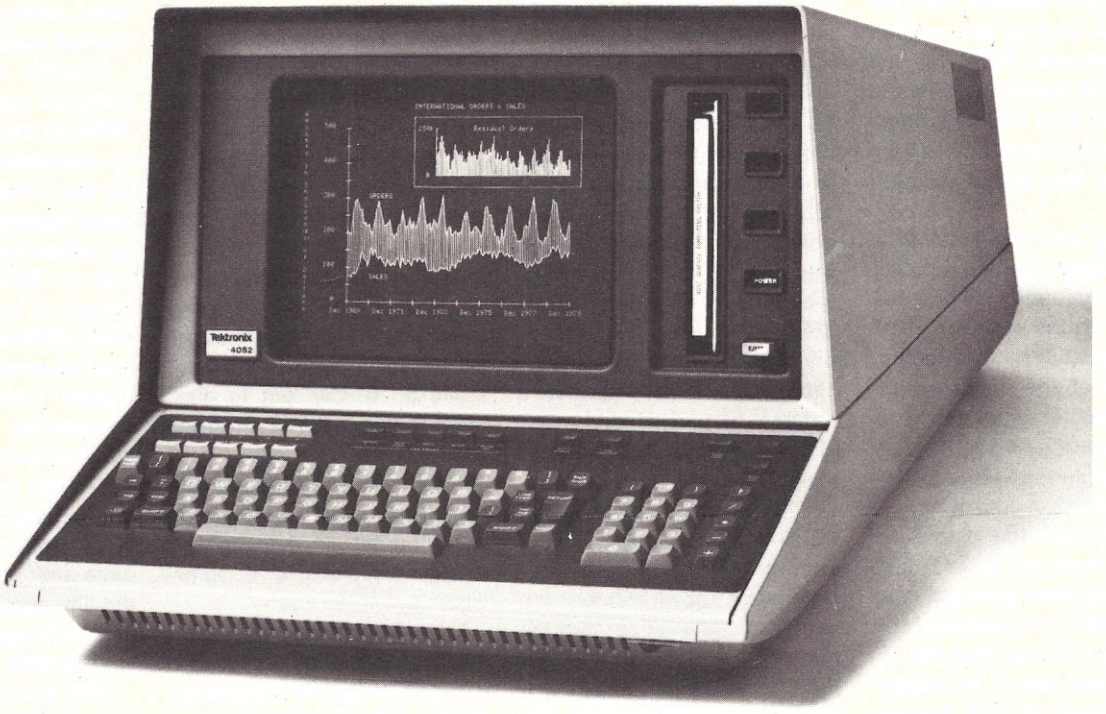


Fig. 1. Dynamic address translator.



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the four bits represent the rightmost hex digit in the address (FFF0 through FFFF for the RAM), they determine where in that RAM data will be written. The data input itself comes from the lower four bits of the data bus.

Writing into the RAM in a simple 6809 system actually takes place fairly seldom — SBUG-E writes into the RAM once, just after it is started up. The rest of the time, the address selector is switched to the A inputs, and the RAM is more or less permanently placed into a read-only mode. But note that the data read (coming from the RAM's data out pins) doesn't go to the data bus; it goes to the address bus!

As you can see from Fig. 1, the top four bits of the 6809's address outputs, A15 through A12, don't go directly out to the address bus; instead, they go to the selector, and through it to the address inputs of the RAM. The top four bits of the address bus come out of the RAM's data outputs. So the top four bits of the address bus on the right need not necessarily be the same as the top four bits of what the 6809 is putting out.

There are two new words applied to addresses here. The address coming out of the 6809 — the address the program "thinks" is being called — is the *logical address*. The address that actually appears on the address bus and goes to memory and I/O is called the *physical address*. In 6800 systems, which have no DAT, the logical and physical addresses are always the same. Here they may be the same, but not necessarily. For instance, if every location of the IC11 RAM is programmed to hold a binary 0000, then regardless of what logical address the 6809 is outputting, the physical address will always start with a binary 0000.

On the other hand, if location 0000 of IC11 is programmed to 0000, location 0001 holds 0001, and so on, up to location 1111 holding 1111. Then the physical and the logical address will always be the same, because the data coming out of the RAM will always be the same as the address going into it.

Since the DAT circuit works on the high-order four bits, it changes the leftmost hex digit of a 16-bit address into some other digit. For instance, it can change a logical 2 into a physical 3, so that every reference to locations 2000-2FFF will actually involve memory at 3000-3FFF instead. Since each 4K block of memory has a different first hex digit, the DAT circuit can move 4K blocks of memory around.

When a 6809 system using SBUG-E is first brought up, the monitor initializes the DAT RAM into a known memory pattern and then goes through memory, one 4K block at a time, testing each block to see if it actually has RAM there. In this way, it determines which physical addresses correspond to real RAM memory. Then, regardless of whether this RAM is in adjacent 4K blocks or not, the monitor readdresses these blocks, via the DAT RAM, to make them adjacent. Hence, regardless of how the RAM boards in a system are addressed, the DAT will readdress them where it wants them, as long as two boards don't have the same address.

But this is not the main purpose; the word "dynamic" in DAT is important too. This readdressing can take place dynamically, that is, as the system is running. SBUG-E doesn't seem involved here, but other system programs can change the DAT addressing too. This would occur, for instance, in time-sharing.

When two or more users are being time-shared on a computer, they each get a chunk of time, called a slice, during which their program runs. When the time is up for one user, his program is stopped and another's starts. This "context switch" can be done in several ways. The DAT can simply be reprogrammed so that the memory blocks assigned to user 1 are simply deleted from the DAT RAM, and the memory assigned to user 2 is relocated, via the DAT RAM, to the same logical memory addresses previously held by user 1. If this is done at regular intervals — every 60th of a second, for instance — each user will get fast enough response that he will be unaware he is sharing time on the machine with someone else.

The context switching could, of course, be done in some other way too. For instance, all the memory assigned to user 1 could be written out to disk, and another user's program and data could be read in from the disk. This procedure would take much longer than leaving the material in memory but simply readdressing it somewhere out of the way.

Dynamic address translation such as this is of limited use if you're limited to somewhere between 32K and 64K of memory. The MP-09 CPU board has facilities for adding much more memory than that.

The Extended Address Bus

As mentioned earlier, there is room for another 74LS189 RAM; this one is optional. This RAM is IC8, which is wired up in a similar way to the DAT RAM in Fig. 1. The only differences are that the data into the RAM comes from the other four bits of the data bus (D5 through D7) and that the data outputs (S0-S3), instead of being part of the 16-bit address bus, become an extension of it. Counting these four bits, the extended address bus becomes 20 bits wide. With 20 bits, we could address 1,048,576 different memory locations for a total of 1024K, instead of just 64K.

Essentially, the lower 16 address lines address a 64K block of memory, while the four new address lines, S0 through S3, provide for 16 such blocks. Let's call each of these 64K blocks a page.

A change from one 64K page to another can be done simply by storing a new 4-bit page number into that optional RAM. But a program obviously can't flit back and forth between pages, since this would greatly slow everything down. Hence, going from one page to another is reserved for special occasions, such as during complete context switches.

Actually, the system can't really be expanded to the full 1024K of memory. Some memory addresses are still needed for I/O, a monitor and perhaps other important programs such as a disk operating system, as well as their required RAMs. Hence, a certain amount of RAM, ROM and I/O will have to exist on every page and should ideally have the same addresses on every page. This eliminates a large area of each page from being used for normal processing, so that the total amount of memory is quite a bit less. SWTP expects the limitation to be 384K total, and their reasons are not yet entirely clear.

Note that making proper use of both the dynamic address translator as well as extended addressing up to 384K of memory requires two things: sophisticated software to keep track of what's going on and where and a need to do all this. There are a great many applications where the need for all this complexity in hardware and software is simply not there.

One hardware change must be made if the address bus is to be extended. As shown in Table 1, the four new address bits, S0 through S3, are sent along four lines on the 50-pin bus, which are normally used for baud rates. On the CPU board, this is accomplished simply by unplugging the MC14411 baud rate generator when the optional memory extension RAM is plugged in.

But since serial interface cards still need baud rates, these now have to come from somewhere else. SWTP is therefore offering a baud rate generator card, which plugs into the 30-pin I/O bus and provides those signals. A few cuts on the motherboard are required to isolate the baud rate lines on the 50-pin bus from those on the 30-pin bus.

The SBUG-E Monitor

SBUG-E is the new SWTP monitor ROM. It is a 2716-compatible 2K by 8 ROM, which resides on the MP-09

CPU board, addressed at F800-FFFF.

SBUG-E has two possible operating modes. As supplied, it permits up to 56K of memory to be installed on the main memory page. But this requires that I/O addresses be moved from the 8000 region, which they occupy in a standard 6800 system, up to E000. (It's not entirely obvious why this should be needed, considering that the DAT circuit should be able to move I/O at will. But one reason is that the monitor has no easy way of detecting, via programming, where the I/O is.) Hence a system will have to be modified to work with a standard SBUG-E; then it will not work with a 6800 CPU board.

However, by changing one byte in SBUG-E, you can retain I/O at address 8000, but then the memory is limited to just 40K total (32K and 8K, combined by the DAT circuit). This requires that SBUG-E be read into memory, that one byte be modified and a new monitor be burned into a 2716 EPROM. (Instructions are in the SBUG-E manual.) Even then, though, there are enough other small changes that the modified system will still not work with an old 6800 CPU board.

The standard SBUG-E requires a system configured like this:

1. An MP-S serial interface plugged into port 1 and I/O addressed at E000. This requires a change to the motherboard.

2. At least 4K of RAM memory, physically addressed anywhere below DFFF.

Wherever that RAM is, SBUG-E will find it and relocate it, using the DAT, to logical address D000-DFFF. The region from D800 up to DFFF will then be used as the monitor scratchpad. (A disk system will need at least 8K just to boot the disk, and most applications would obviously need much more.)

SBUG-E can be thought of as divided into four areas: the user command processor, a set of user-callable subroutines, an interrupt and breakpoint handler and an initializer routine concerned with, among others, initializing the DAT and the various ports.

The user command processor is a greatly expanded version of what MIKBUG or SWTBUG had. Table 3 lists the commands from the keyboard that SBUG-E will respond to.

Control-A —	Alter the A accumulator
Control-B —	Alter the B accumulator
Control-C —	Alter the condition codes register
Control-D —	Alter direct page register
Control-P —	Alter program counter
Control-U —	Alter user stack pointer
Control-X —	Alter X index register
Control-Y —	Alter Y index register
B hhhh —	Set breakpoint at location hhhh
D —	Boot an SWTP 8-inch floppy system
U —	Boot an SWTP 5-inch floppy system
E ssss-eeee —	Examine memory from starting address ssss to ending address eeee
G —	Continue from a breakpoint
L —	Load tape
M hhhh —	Alter contents of memory location hhhh
P ssss-eeee —	Punch tape using specified addresses
Q ssss-eeee —	Test memory locations ssss through eeee
R —	Display register contents
S —	Display contents of stack
X —	Remove any existing breakpoints

Table 3. SBUG-E commands.

User-callable subroutines now use an address table at the very start of the monitor, locations F800 and up, to point to each subroutine. This allows monitors to be easily updated without having to go through contortions to keep all starting addresses the same as in previous versions. Standard subroutines such as INEEE, OUTEEE or PDATA exist (some with new names), as well as a few new ones: INCHECK checks if a character is waiting

at the control interface; PCRLF prints a carriage-return and line-feed; LRA finds out what physical address a logical address corresponds to.

Finally, the interrupt and breakpoint handlers are written in a way that the interrupt system can more easily be used for user programs. There are three SWI instructions in the 6809, and each is provided a different interrupt vector address in RAM.

Modifications to Use MP-09/SBUG-E

In order to plug an MP-09 CPU board into an existing 6800 computer, you have to make a number of modifications. Let's describe them very briefly; they are covered more thoroughly in the MP-09 manual.

If 40K of memory is enough (32K in addresses 0000-7FFF and 8K somewhere else, but the DAT will make it appear continuous), then the I/O address decoding on the motherboard need not be changed, but SBUG-E will have to be modified and reprogrammed into a 2716. (This will obviously have to be done before the 6800 CPU board is unplugged.) The MF-68 mini-floppy is supported in this case, but the DMAF full-size floppy will not work like this.

To expand above 40K or to use the DMAF floppy, all I/O must be moved from 8000 up to E000. This requires that the motherboard have several traces cut and several new wires added. (This modification is much more complicated on the older MP-B board than the newer MP-B2 motherboard.)

In either case, the RESET switch from the front panel will have to be rewired from the motherboard; it connects directly to a connector at the top of the CPU board. Another motherboard change will involve the NMI and FIRQ connections, which are now different.

If a DMAF1 disk controller board is used, its addressing circuits will need to be changed so the disk can be addressed at F000-F3FF, instead of the 9000-93FF used in 6800 systems. But note: Once this is done, you cannot plug your 6800 CPU board back in. It's not exactly an irreversible change — you can go back — but it's just as much work to go back as it is to switch to the MP-09 in the first place. Hence, before switching to the 6809, it would be a good idea to make sure that you have all your software ready: BASIC, assembler, editor, processor, disk operating system, disassembler, utilities. That's a tall order.

> **Many think that SWTP has gone too far. Their system is versatile, but by taking such a gigantic step, they are placing a burden on those who want to convert existing systems.**

Alternative 6809 Approaches

Private conversations with many people involved in 6800 hardware and software indicate that many think SWTP has gone too far. Their system is versatile, but by taking such a gigantic step, they are placing a tremendous burden on those people who want to convert existing systems.

As an example of what I'm talking about, consider my own system. Since I have some nonstandard I/O equipment, such as a Selectric typewriter, I have a number of I/O subroutines in 2716 EPROMs on my MP-A2 CPU board. They are presently addressed from C000 through CFFF.

There are extra EPROM sockets on the MP-09 board, but as mentioned above, they cannot be used because their addresses conflict with system addresses. That's easy, you say. Either modify the CPU board to change the addresses or else install a separate EPROM board.

That raises some questions, though. What will SBUG-E do with that EPROM? Will the dynamic address translator move its addresses to some other place in memory? Will that address be the same every time I power up the system? Will it be moved dynamically around with time? Or, worse yet, will the DAT simply ignore my EPROM and assign no addresses to it at all?

These questions apply equally to non-SWTP hardware. If you have an SSB or Percom disk, where will the EPROM be? If you have a parallel interface for a paper tape reader, or whatever, where will the DAT put it? It sure makes it difficult for SWTP competitors to offer any kind of hardware or software. Every customer's DAT might assign different addresses to it! For this reason, there are some other approaches.

The Percom 6809 Boards

Percom Data Company has two 6809 boards in the works: One is a simple adapter for plugging a 6809 into an existing 6800 CPU board; the other is a completely new 6809 board.

The 6809/6800 adapter board was described in the August 1979 issue of *68 Micro Journal* in an article by Byron Seastrunk. It contains a 6809, two ICs containing a few gates and inverters, a crystal and two resistors. The circuit, which was published in the *68 Micro* article, mounts on an MP-A2 CPU board and plugs into the socket that originally held the 6800.

The circuit could be built from the article or from a $69.95 kit available from Percom. Either way, though, you need a 6809-based monitor. Percom is also offering their PSYMON on either a 2716 ($69.95) or on a Percom diskette ($29.95) for burning your own EPROM. Using it with an MP-A2 board is easy since the monitor can plug right into it. For use with an MP-A board, you'd need another EPROM board, plus a few cuts on the MP-A board to disconnect its own ROM socket.

Use of this adapter board still doesn't make it easy to switch back and forth between a 6800 and a 6809, but at least it does not require modifying the motherboard or memory boards. I suppose the best approach would be to wire up a separate MP-A2 board just for use with the 6809 adapter and then switch entire CPU boards. (Notice: You can't do that with the SWTP 6809 board because the motherboard and bus must be changed and are therefore no longer compatible.)

The other Percom board is a completely new 6809 CPU board. Percom's major aim was to have a CPU board that was completely compatible with existing hardware, yet had some new features of its own. It has enough jumpers so it can be configured either to use exactly the same bus as a 6800 system or to use a bus very much like the modified SS-50C bus used by SWTP.

PSYMON, Percom's monitor, lies at addresses FC00-FFFF. Right on the CPU board are a parallel port at F7FC-F7FF and a serial port whose ACIA is at F7FA-F7FB. Two 2114 RAMs on the CPU board provide 1K of RAM at F000-F3FF. All these addresses are fully decoded, so that other parts of this address range can be used for other purposes without interference.

Percom also is introducing a video board they call the Electric Window (EW). Their CPU board and monitor are set up to use the EW in the following way. When first powered up, PSYMON checks the video board's addresses to see if it is there. If the EW is connected,

then it configures itself to use the EW for output and the parallel port on the CPU board for keyboard input. The CPU board has 1K of RAM, so that the CPU/EW combinations can run programs all by itself.

If the EW is not connected, then PSYMON configures itself to use the serial port on the CPU board for I/O. There is a connector at the top of the board exactly like the one at the top of an MP-S serial interface card, so the terminal is just unplugged from the MP-S into the CPU board. The CPU board has baud rate generators, so, again, this one board can run programs.

Percom's CPU board does not have the dynamic address translator, since Gimix, SSB, Percom and other manufacturers offer devices, such as disk controllers, that need to know what addresses they are at. Since the SWTP monitor and DAT circuit put them where they want to, the DAT circuit on an SWTP CPU board would have to be disabled anyway to bring up the system. So Percom omits the DAT.

But there is provision for extended addressing. Normally, the CPU board's baud rate generator feeds its own ACIA as well as the baud rate lines on the bus. If no external serial interfaces are needed, then the baud rate lines and the buffer on the CPU board used to drive them will be used for extended addressing.

With just 32K of memory from 0000-7FFF, all the regular I/O can be left at 8000 (except for the terminal, which is now plugged into the CPU board). Otherwise, by modifying the motherboard, you can plug in up to 60K of memory if the I/O is moved up to the F000 region.

PSYMON comes in a 2708 EPROM and fits into one of two 2708 sockets on the CPU board; the other socket can be used for extended routines. But the two 2708 sockets can be jumpered to use either the Intel 5-volt 2716 or the TI TMS-2716, for a total of 4K of ROM. Normally, though, these sockets are addressed at F800-FFFF for 2708s, and the onboard 1K RAM is at F000-F3FF. The Electric Window would be at E800.

PSYMON is quite a bit simpler than SWTP's SBUG-E. It occupies 1K at the very top of memory, but as soon as it initializes, it checks whether there is another ROM plugged into the other ROM socket. If so, it jumps to that ROM. Hence, PYSMON can be easily extended for more commands just by plugging in another IC.

PSYMON's Basic Command Functions

Memory examine is similar to MIKBUG's, but it saves the last address you looked at. It checks for bad memory, but only prints a question mark when it finds a location that won't write properly. This is done so that it is easier to change contents of I/O port registers.

Load and Save are also similar to MIKBUG, except that the load prompts for beginning and ending address instead of having to use addresses A002 through A005.

Up to ten breakpoints can be set into a program. They can be set and unset selectively or all at once. A command exists to print out the addresses of all outstanding breakpoints. When a breakpoint is encountered in a program, it is deleted.

Register dump and GOTO are similar to those of 6800 monitors.

Percom has a different philosophy on monitors and I/O. Their thought is that monitors should be simple, so they don't try to anticipate all the possible I/O and memory combinations users might hook up to the system. They did, however, try to make their I/O somewhat device-independent by having a small area of memory in RAM, called a DCB, or device control block, devoted to each I/O device. This DCB specifies the type of each serial or parallel device and where it is addressed. To change an I/O device, it's only necessary to change the DCB pointer in the scratchpad RAM. This allows echoing and I/O-to-I/O transfer by manipulating the DCBs.

✓ Reader Service—see page 227

Percom is trying to make their CPU board versatile enough so that most SWTP and TSC software is likely to run on it. On the other hand, they also have to support their own disk systems, which require different disk drivers.

Their past approach in this respect has been to offer their own software (they have an excellent assembler and random BASIC, for instance), adapt other companies' software to run on their systems (Ed Smith's software is a good example), and as a last resort, simply provide at either low cost or no cost at all patches to other people's software to make it work on their disks (for instance, they have patches to Microware's cassette A/BASIC, Smoke Signal Broadcasting's Source Generator and TSC's Text Editor and Processor). It's a fairly safe bet that they will do the same for their 6809 CPU board.

The Gimix CPU Board

Another contender in the 6809 CPU board race is Gimix (1337 West 37th Place, Chicago IL 60609).

About a year ago, Gimix introduced their new 6800 mainframe. Compared with the cabinets SWTP users have gotten used to, this one is built like a tank. (Even the screw holes line up.) The power supply itself probably weighs more than the complete computer of "the other brand." Needless to say, the price is several times higher, but for industrial users this may not be significant.

About the middle of 1979, Gimix started to ship this mainframe with their new 6800/6809 motherboard. This board has some of the features that will be needed in 6809 systems of the future.

Aside from a variety of jumpers to give all sorts of options, Gimix puts the baud rate generator on the motherboard. This releases the five baud rate lines on the 50-pin bus, yet provides the required signals to I/O boards.

If you've noticed the RS2 and RS3 lines in Table 2, you may have wondered what they were. 6800 systems had a pair of lines called RS0 and RS1, which were actually two buffered lines from the address bus and were used by the I/O interfaces to give each I/O slot up to four addresses. For instance, you may remember that an MP-C control interface in port 1 had four addresses, 8004 through 8007, which were selected via the RS lines.

But there were some cases where four addresses per port were not enough. For instance, the SWTP MF-68 disk controller required a jumper in port 5, so that some of the addresses of port 5 were available to the disk interface in port 6.

The new 6809 systems anticipate those problems by providing two more address lines to the I/O ports, so that each I/O port can have up to 16 addresses. The Gimix motherboard also has those lines; its I/O block is therefore 32 bytes long if only four addresses are used per port (four addresses times eight ports), 64 bytes if eight addresses are used or 128 bytes if 16 addresses are used. The decoding is thorough enough that these are all the addresses that I/O requires.

The Gimix motherboard also has an optional circuit that provides the appropriate Memory Ready (M.RDY) signal to slow down the CPU whenever an I/O operation is being done. The idea here is to give I/O a bit of extra time if a fast 2 MHz clock rate is used, so that older I/O boards (and probably slower ones as well) can be used.

Now, to go with their new cabinet and motherboard, Gimix has designed a CPU board. Details are a bit sketchy at the time of writing, but it is obvious that Gimix is going another route. Instead of writing their own software to fit the board, they are designing the board to fit a major software undertaking that Motorola and Microware Systems Corp. are working on.

What About Software?

TSC has already announced their initial 6809 programs. At first glance, they appear to be simply reassembled versions of their 6800 programs, with some updating to adjust such factors as timing loops. Their 6809 programs include:

6809 FLEX with Editor and Assembler. This requires memory at C000 and costs $90.

The Text Editor ($35) and the Assembler ($40) are available separately in cassette form.

TSC BASIC at $65 should turn in a stunning performance in the speed department. Unfortunately, with just six-digit math, it's a little limited for any kind of business application.

The 6809 Debug Package ($75) for tracing and debugging programs.

TSC's advertising doesn't answer some important questions, such as whether their new FLEX will read text and binary files from disks written on a 6800 system. That's crucial if you're going to convert some of your old 6800 software to the 6809.

Another 6809 product is a 6809 simulator that will run on a 6800; it's available from Micro Works.

Two products that I think will be essential are a 6809 assembler that will run on a 6800 and a 6800 disassembler that will run on a 6809. Nobody seems to be offering them, but for anyone who wants to convert his 6800 programs to a 6809, they would be very useful.

Perhaps the most ambitious 6809 software project is the one being developed jointly by Microware and Motorola. It is to be a fast and versatile BASIC, which Motorola intends to sell in ROM at a low price. (Gimix is waiting for it to appear before finalizing their CPU board. Wonder whether it will be compatible with the SWTP approach.)

The BASIC, which is called BASIC-09, is an incremental compiler; that is, each line is partially translated as it is entered. This also means that syntax errors are caught right away.

It is meant to be an expanded BASIC, which has all of the "standard" BASIC features, as well as some versatile extensions to make it more like PASCAL. In fact, Motorola hopes that it will become more popular than PASCAL. Much like PASCAL, it will have IF . . . THEN . . . ELSE; WHILE . . . DO; REPEAT . . . UNTIL-type statements. It's supposed to be procedure-oriented; that is, a program is divided up into more-or-less independent procedures, each of which handles a specific job. Each procedure can have variables that are strictly local and whose names can be reused elsewhere without conflict. Procedures are called by a name, along with some arguments for input or output from the procedure. Variable names can be any length.

It is also supposed to have user-defined data structures; for instance, a data structure can be thought of as a special-purpose array whose entries have different characteristics.

> **Everyone must make his own decisions on conversion to the 6809, but my own thought is that this is the time to sit back and wait for the dust to settle. Perhaps you shouldn't switch at all.**

BASIC-09 has many other features, but the final language will be determined by how much Motorola can squeeze into one ROM.

The operating system, OS-09, is also being worked on but may not be available until later. It's designed for multitasking — running several different programs (tasks) at the same time, while they share programs, memory and I/O devices to some extent. That is quite an interesting, and advanced, concept. The question is, will it work with the XYZ CPU board?

Standards and Compatibility

The problem with all this is that different manufacturers are seemingly headed in different directions. Once you pick a particular hardware approach, you are committing yourself to a whole system. It's like buying a Kimura camera . . . only Kimura lenses will fit, and only Kimura makes the right size film. Unfortunately, this will bring you down to the level of all our S-100 friends, who have that problem all the time. It kills the one feature of our 6800 systems: Every 6800 system is like any other one in terms of addresses, and so if you buy a new piece of hardware or software, you need only plug it in, and it will work.

Everyone must make his own decisions on conversion to the 6809, but my own thought is that this is the time to sit back and wait for the dust to settle. And perhaps you shouldn't switch at all.

For me, switching to the 6809 processor would obsolete all my software investment, which at this point is several hundred dollars' worth. Although the 6809 is supposedly compatible with the 6800 in software, its machine language is different. Hence all my software would have to be reassembled to work. For those programs for which I have the source code, this is feasible. But for the rest it would be very difficult.

Even so, much of this reassembly would have to be done before switching CPUs, so that the instant the new 6809 CPU was up, I would have all of the software I needed—a monitor, disk operating system, editor. Since it is likely that simple reassembly might not be enough, I then visualize long periods of switching back and forth between new and old CPUs before everything works . . . not to mention that I would need a cross-assembler — an assembler that translates 6809 code but runs on the 6800.

I am sufficiently happy with my present system that I'm not sure I'd want to go through this hassle. Just talk to any commercial data processing manager who went through the job of converting from the IBM 1401 to an IBM 360 back in the 60s. There are some harrowing tales there.

I also have a hunch that the days of reasonably priced software are over. One of the big pluses that often swung a sale toward the SWTP system was the price of BASIC and Cores. What other system could boast an excellent—if slow—BASIC for $10 or an editor and assembler for $15? Robert Uiterwik wrote our SWTP BASIC more out of love than for any interest in the cold, hard stuff. And SWTP was in the hardware business; software was an added incentive, not a business for them. Considering copying costs and all that, they probably lost money on every cassette they sold.

But look at the software market now. SWTP is, I think, leaving the software market altogether. The latest TSC BASIC is $50 or so; Microsoft's quoted price for their 6800 BASIC is $50,000.

To some extent, the nature of the customer has changed. Previously, you bought BASIC for $10, and if it had bugs, then a few months later you bought the next version. In the meantime, you changed your program so it wouldn't be bothered by the bugs.

But now, with the small-business user in the act, that won't happen. If there is a bug, he will expect to be able to call up the software house and get a fix. When a patch comes up, he wants it sent to him automatically. Naturally, that changes the price the software house can charge.

So, assuming the higher software prices that seem to be coming, I suspect that the price for switching to a 6809 system will break down as shown in Table 4.

Maybe I'm being overly pessimistic, but the question remains: Is it going to be worth it? To paraphrase a popular song, "What'll we have that we ain't got now?"

Next month, we will discuss some techniques for single-drive disk systems, converting the SWTP 2716 EPROM programmer to work on 2708 EPROMs and other EPROM boards and programs. ■

Hardware (CPU Board)		$175
Software:	BASIC	$ 65
	Editor	50
	Assembler	30
	Text Processor	50
	Disassembler	50
	Debug pack	75
	DOS	50
	Disk utilities	75
	Software total	$445
	Total	$620

Table 4. Estimated cost of switching to a 6809 system.

Allan S. Joffe W3KBM
1005 Twining Rd.
Dresher PA 19025

Outer Limits Addition

This handle on programming lets you smash some of the limits on programming.

```
10  REM LARGE NUMBER ADD PROGRAM BY JAY JOFFE
20  REM MODIFIED BY W3KBM
25  CLEAR
30  CLS
40  CLEAR 2000:REM ADDITION OF LARGE INTEGERS
50  DIM A(100)
60  DIM B(100)
70  DIM N$(100)
100 DIM T(100)
110 PRINT:PRINT
130 PRINT "THIS IS AN INTEGER PROGRAM...NO DECIMAL POINTS PLEASE"
140 PRINT "INSERT NUMBERS WHEN PROMPTED BY ?": GOTO 160
150 GOTO 140
160 GOSUB 340
170 GOSUB 400
180 PRINT "----------"
190 PRINT "A+B=";
200 GOSUB 560
210 GOSUB 630
220 FOR W = 2 TO 100: A(W)=Ø: B(W)=Ø : NEXT W: GOTO 25
230 GOTO 140
240 GOSUB 400
250 GOSUB 630
260 FOR X= (101-LEN(N$)) TO 100
270 T(X)= ASC(MID$(N$,Y,1))-48
280 IF T(X)>9 OR T(X)<Ø  THEN GOTO 310
290 Y=Y+1
300 NEXT X:GOTO 330
310 PRINT "NON NUMERIC DATA"
320 FOR X = 1 to 440:NEXT X: RUN
330 RETURN
340 Y=1: N$=""
350 INPUT "A=";N$
360 SIZE=LEN(N$)
370 GOSUB 260
380 GOSUB 780
390 RETURN
400 Y=1: N$=""
410 INPUT "B=";N$
420 SIZE = SIZE-LEN(N$)
430 FOR J=1 TO SIZE
440 J$=J$+"Ø" :NEXT
450 N$=J$+N$
460 GOSUB 260
470 GOSUB 770
480 RETURN
490 FOR P= 100 TO 2 STEP -1
500 IF A(P)<1Ø  THEN GOTO 540
510 C= INT (A(P)/10)
520 A(P-1)=A(P-1)+C
530 A(P)=A(P)-(1Ø *C)
540 NEXT P
550 RETURN
560 FOR R = 2 TO 100
570 A(R)=A(R) + B(R)
580 NEXT
590 GOSUB 490
600 RETURN
610 GOSUB 720
620 N$=""
630 GOSUB 790
640 GOSUB 720
650 N$=""
660 FOR X= T(1) TO 100
670 N$=N$+CHR$(A(X)+48)
680 NEXT X
700 PRINT N$: INPUT "PRESS ENTER TO CONTINUE";D$
710 RETURN
720 FOR X= 2 TO 100
730 IF T(X)=Ø  GOTO 750
740 T(1)=X: GOTO 760
750 NEXT X
760 RETURN
770 FOR X =1 TO 100:B(X)=T(X):NEXT:RETURN
780 FOR X =1 TO 100:A(X)=T(X):NEXT:RETURN
790 FOR X =1 TO 100:T(X)=A(X):NEXT:RETURN
800 END
```

Program listing.

Once you get past certain items, such as breathing, eating and sleeping, it becomes a bit sticky to define what else may be of Universal importance. For instance, as the owner of a brand new TRS-80 Level II, you may not care that you cannot get last-digit accuracy with the following addition problem: 99-9999999888888888 + 2. 1E + 18 is what will be displayed on your monitor. You can tell by inspection that the accuracy to the last digit will show the real-life answer to be 999999999888-888890. Certainly, you will not let "hitting a limit" cause you to send your TRS-80 back to its mother with a note asking, "What gives?" It is all too true that for practical folk the difference in the two answers is not going to mean much.

However, for you fans of the infinite, you folk of all persuasions that aspire to be programmers, limits are annoying. They represent a chance to extend the capabilities of your machine into the outer limits and at the same time exercise your skills at what it is really all about, in other words, programming.

The Program

By now you must be fairly sure that there is a way to turn your TRS-80 into a nitpicking, last ditch, last digit, adding fool. The Program listing here provides one answer to the problem.

The largest portion of this program was produced by my son, Jay, in response to my initial frustration with the basic premise of it all: "Why can't I get this machine to do what I think it should do rather than what I think I told it to do?"

Examining the listing, be aware that it is an integer program only. If you try to slip in a decimal point, one of the nicely nested subroutines will print the message listed in line 310, "Non Numeric Data," and send you back to the start. It will do the same thing if your wandering fingers should strike a letter on your keyboard. The program, fundamentally, puts the two numbers to be added into aligned arrays and then proceeds to add them and print out an answer.

If you examine the listing closely, you will see a variable called SIZE, which first appears in line 360. This line with its companion lines inserts leading zeros into the appropriate array cells that may or may not be filled with pertinent numerical information. If you calculate a sum with pencil and paper, you do the same thing by carefully aligning the numbers one under the other so you can properly add them. You do not write in the leading zeros, but your method is the same. You can mentally ignore these gaps, but if the computer is to function properly it must fill in those gaps, since it has no imagination to help it while it adds.

Consider line 340 in the program—Y = 1: N$ = "". The "" may possibly be unfamiliar and lead to problems when you key the program into your machine. This symbol is composed of two quote marks with *no* separation as typed, and essentially it provides a NULL, which resets the value of N$ back to zero.

Jay tends to lean toward a type of structured programming that may initially be hard to follow due to the liberal use of nested subroutines. You may knock this approach, but it does work well. ■

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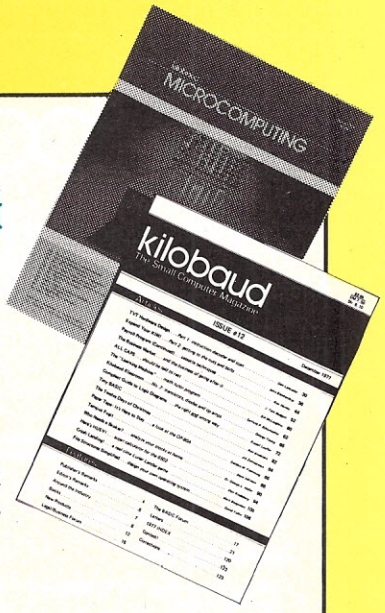

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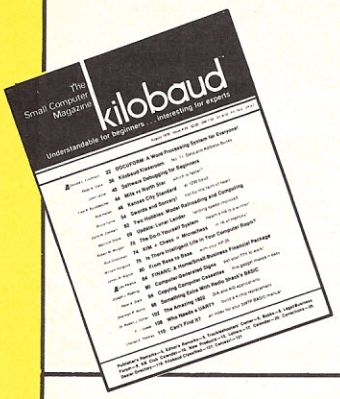

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- ☐ Consider a MITE Printer . . . *alternative to the ASR-33*
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- ☐ Kilobaud Klassroom . . . *No. 6: voltage, current and power supplies*
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- ☐ Build the $35 Modem . . . *uses the MC14412 and a UART*
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- ☐ TVT Hardware Design . . . *Part 1: instruction decoder and scan*
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kilobaud microcomputing

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TM990/189 University Board

Is Texas Instruments' TM990/189 a microprocessor's microprocessor?

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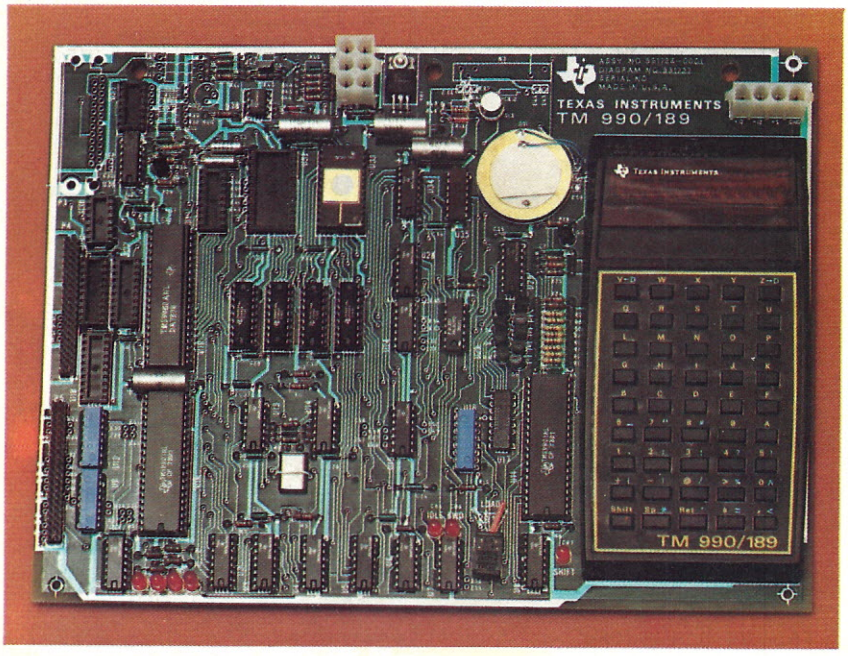
I don't know how many other hobbyists wait as long as I do to really get into something, but my major contact with the microcomputer world has been to read about it and just be satisfied, in a vicarious sort of way, with the fascination of the microprocessor. I've always thought that one of these days there'll emerge a microprocessor's microprocessor that I'll really learn on, become a veritable genius at and live happily ever after.

Texas Instruments' TM990/189 University Board comes closest to fitting my scenario. Time will tell if it emerges as a microprocessor's microprocessor, but you pay your money, you take your chances. TI has provided an approach that, for me, does it all: alphanumeric keyboard, display, monitor, assembler, audio cassette capability, EIA and TTY interface options, programmable I/O controller, addressable LEDs, a squeaker speaker (piezoelectric disk), matching power supply and a versatile 16 bit CPU, the TMS 9980.

One of its biggest drawing cards is 570 pages of a self-paced tutorial text. My previous reading about this sport has made me conscious of a checklist of features . . . TI seems to have packaged about all my novice mind and budget could imagine into its University Board.



TM990/189 University Board. (Photos courtesy of Texas Instruments)

Let's look at the features of this 8 3/16 × 11 inch (20.8 cm × 27.9 cm) printed circuit board, which is three-hole punched so you can slip it into a three-ring binder.

The brains of the board is a TMS9980, the microprocessor. This is a software-compatible member of TI's 9900 family of microprocessors. It is a single chip CPU that has an 8 bit data bus, on-chip clock and is a 40-pin device. Wait a minute, I can hear you saying, I thought this was a 16 bit CPU. Well, it is.

The TMS9980 has an external 8 bit data bus, but internally it has a 16 bit data bus. There's an 8 bit latch right inside the 9980. Each 8 bit data chunk that enters the 9980 via the external eight data bus pins is immediately paired up with the preceding eight bits. The combined 8 bit values form the 16 bit internal word.

Monitor Program

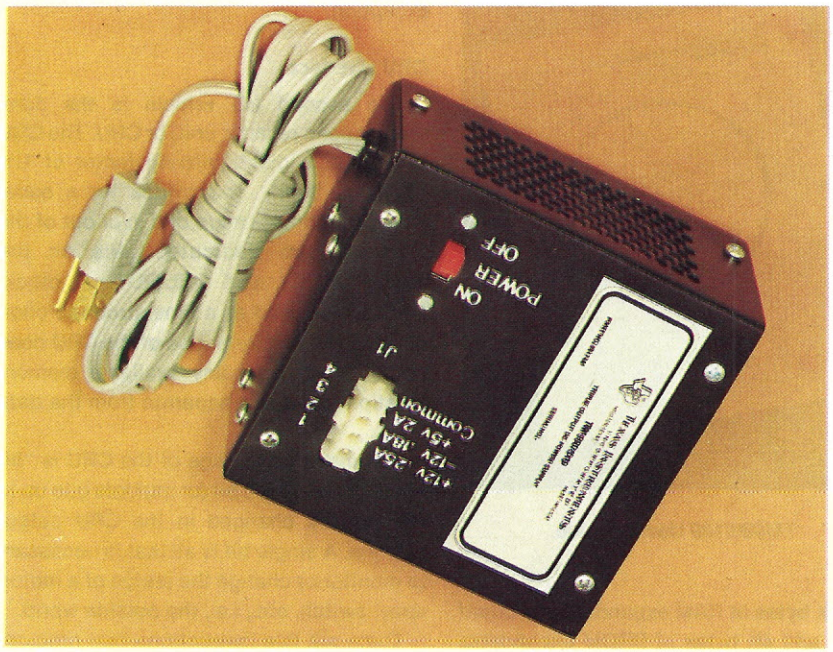
The EPROM resident monitor, called UNIBUG, enables you to communicate with the TMS9980. The monitor program provides fifteen commands and seven subroutines. The UNIBUG commands are shown in Table 1.

In addition to the monitor commands, there are seven utility subroutines that perform I/O functions. These subroutines are called through the XOP (extended operation) assembly-language instruction. Table 2 shows these user-accessible utilities.

The monitor program has a roommate inside the 4K PROM, a two character symbolic assembler. After entry of the A command from the keyboard, the monitor passes program control to the resident symbolic assembler. The assembler program interprets assembly-language source statements into object code. This saves you the laborious, and often error-prone, task of looking up hexadecimal op codes for any

Input	Results
A	Assembler Execute
B	Assembler Execute with current symbol table
C	CRU Inspect/Change
D	Dump memory to cassette
E	Execute to breakpoint
F	Status Register Inspect/Change
J	Jump to EPROM
L	Load memory from cassette
M	Memory Inspect/Change
P	Program Counter Inspect/Change
R	Workspace register Inspect/Change
S	Single Step
T	"Typewriter" program
W	Workspace pointer Inspect/Change
Ret	New Line request

Table 1. UNIBUG commands.



TM990/519 power supply.

one of the 69 instructions of the TMS9980, plus formatting them for various addressing modes. The resident assembler will save those of us in the microcomputer novitiate anywhere from two to three light-years of time and a like amount of debugging frustration.

Just like the "big ole computers," the University Board assembler has several versatile assembler directives (see Table 3).

Also, labels and comments can be used. Labels may consist of one or two characters—the first character must be alphabetic; the second character may be alphanumeric. Comments can be part of the source statement and may include any printable character.

Keyboard

So how do I, the lowly human, talk to this fantastic monitor, symbolic assembler and CPU? Simple, through the integral keyboard. Any breathing electronics jock knows that TI is in the calculator business. Well, they very niftily took one of their 45-key keyboards and a ten digit seven-segment display and interfaced it to the University Board. The 45 keys operate in both a shifted and unshifted mode. The keys are shifted when you depress the SHIFT key; in this mode, a shift LED is illuminated.

The keyboard display consists of ten seven-segment LEDs. All of the letters of the alphabet, numbers 0-9 and punctuations .''#.;:,?!+ – ()@/>%^*'$=< are available. How can all this be done with seven segments?

TI uses a stylized font—which means that some of the letters and punctuations will look rather strange at first (see Example 1, which demonstrates a v, K and M). You may grow to prefer some of the stylized letters and adapt them to your everyday life. In fact, it will help keep your hobby just esoteric enough so you can still "amaze your friends."

Although the display is ten digits, it is capable of displaying any nine contiguous characters of a maximum 64 character line. The "shift display left" and "shift display right" keys rotate the display six characters at a time in a ring buffer to enable viewing the 64 character line.

If you are an advanced enthusiast and have an EIA or TTY terminal, you can populate the EIA or TTY options on the TM990/189. The printed circuit board is predrilled and etched for the few needed parts, and the *User's Guide* details their installations.

v SHOWS UP AS ⊔

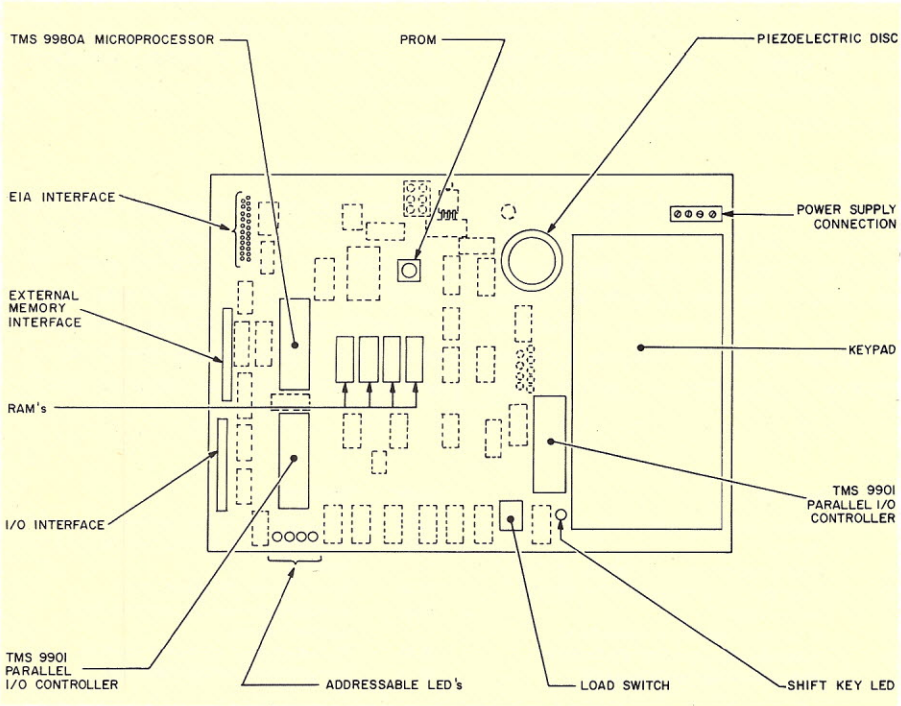
K SHOWS UP AS ⊦

M SHOWS UP AS ⊓

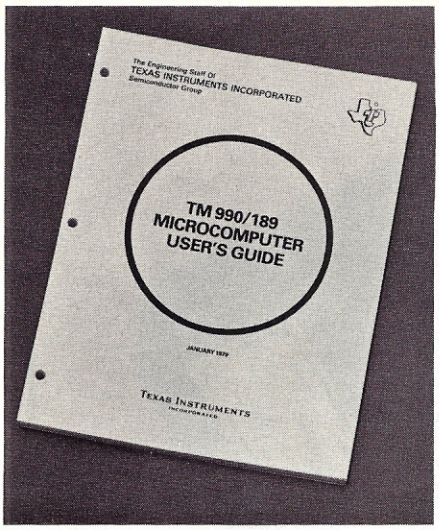
Example 1.

Memory

Every microcomputer system, by definition, has memory. The TM990/189 comes



Schematic depiction of power supply.



TM990/189 User's Guide.

with 1K bytes of RAM expandable on-board to 2K, and 4K bytes of PROM expandable on-board to 6K. The 4K PROM contains the UNIBUG Monitor and Symbolic Assembler. The user can add either a 1K × 8 or 2K × 8 EPROM in the expansion EPROM socket provided.

For memory expansion beyond what is on the board, all key address and data lines are brought to a 40-pin connector where additional memory may be interfaced. TI provides a bus expansion interface on the printed circuit board, which you populate to interface to off-board memory. This option will enable you to utilize the total memory address capability of the TM9980 CPU, 16K bytes.

The University Board may be interfaced to an audio cassette for mass program storage. The *User's Guide* gives the connection details and parts required. To accomplish this, again, the printed circuit board has the etches, but the user supplies the parts—a relay and a transient protection diode.

Ever since I first started reading about microprocessors, I've wondered about I/O, or, how can I get this circuit to actually do something? The University Board has two main vehicles to the outside workaday world. First, there is memory-mapped I/O that treats I/O as a memory location. Almost all microcomputer systems have this capability; the TMS9980 CPU is no exception.

CRU Interface

The second I/O vehicle is the communications register unit, or CRU. The CRU is a definite distinguishing factor of TI's TMS9900 family. It provides for a serial transfer of one or more bits in or out of the CPU via two dedicated pins on the 9980—CRUIN and CRUOUT. A clock, CRUCLK, is used as a time strobe to coordinate data transfers. Use of the CRU does not subtract from any available memory locations, and it is separate from the data bus.

The major advantage of the CRU is "bit diddling." A single bit (or multiple bits up to 16) may be changed in the CRU output scheme. A single bit is all that is necessary to monitor or change the status of a motor, relay, switch, etc., i.e., the outside world.

There are five instructions that program the CRU interface:

LDCR—Enables the user to load from memory a pattern of 1 to 16 bits and serially transmit this pattern through the CRUOUT pin.

STCR—Enables the user to store into memory a pattern of 1 to 16 bits obtained serially at the CRUIN pin.

SBO—Sends a "logical one" through the CRUOUT pin.

SBZ—Sends a "logical zero" through the CRUOUT pin.

TB—Tests the value at the CRUIN pin and reflects the test results in the equal bit of the Status Register.

The last three instructions, SBO, SBZ and TB, are the real aids to the control applications. They enable you to turn on and off loads as well as check their status. The CRU becomes a fascinating concept beyond the typical memory-mapped I/O systems.

Power Requirements

The nominal power requirement with the on-board memory options fully populated is +5 V @700 mA, +12 V @100 mA and −12 V @16 mA. Luckily for me, TI supplies a matching fossil-fuel-fired power plant, the TM990/519, to supply the required "juice." If you start adding off-board options, you'll soon run out of power supply. So keep your power budget in mind with respect to the TM990/519's capabilities.

Documentation

A major ingredient of the TM990/189 University Board package is the tutorial text, entitled *Introduction to Microprocessors—Hardware and Software.* This 500 plus page document stepped me through every inch of the system. It makes liberal use of illustrations, understandable and practical examples, and it is directly keyed to the TM990/189 for immediate hands-on reinforcement. (I especially enjoyed the illustration that built up to a Morse code translator. With a little bit of tweaking I'll be able to use it with my ham radio!)

The text is simple enough for the relative novice to use, but the book's authors (George Goode and Associates, Dallas, Texas) point out that the book can also be used as the central text in an introductory three-hour college course on microcomputer systems. The chapter titles are:

1. Overview of Computers, Microprocessors and Microcomputers
2. Arithmetic, Logic and the ALU
3. Introduction to Computer Addressing and Program Development
4. Assembly Language
5. Memory Systems
6. Input/Output Concepts
7. Input/Output Design
8. Modular Programming
9. Software Engineering
10. Product Development

In addition to the tutorial text, TI supplies a well-written 150 page user's guide. The documentation is of professional quality and highly readable.

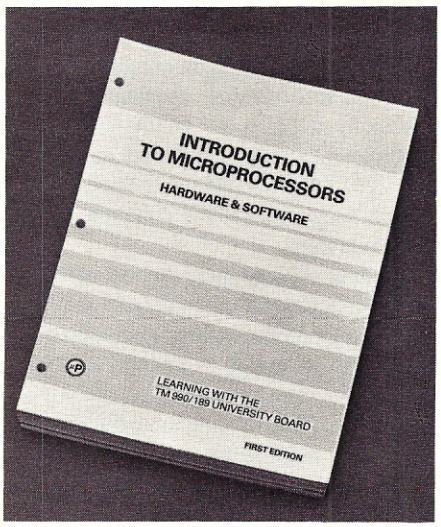
The assembled board (no kits), tutorial text and *User's Guide* is $299. The tutorial text alone is $19.95; *User's Guide*, $5.95; TM990/519 power supply, $65. ■

XOP#	Function
8	Write one hexadecimal character to the terminal
9	Read hexadecimal word from the terminal
10	Write four hex characters to the terminal
11	Echo character
12	Write one character to the terminal
13	Read one character from the terminal
14	Write a message to the terminal

Table 2. Utility subroutines.

Inputs	Functions
AORG	Absolute origin of the statement
BSS	Block of memory reserved with starting symbol
DATA	Sixteen bits of immediate value
END	End of program, exit to monitor, load program counter
EQU	Symbol equated to value in operand
TEXT	String of ASCII coded characters

Table 3. Symbolic assembler.



TM990/189 tutorial text.

With these disks, I can turn your TRS-80 into a serious computer.

I'm Irwin Taranto, and I've put the first computer into more than 300 different businesses.

It's taught me that the TRS-80 is an elegant piece of hardware despite its low price. Given the right programs, it can jump through hoops.

Put simply, I have the right programs. Four of them are the genuine Osborne & Associates systems, originally designed for the $30,000 Wang computer. I've made a few minor modifications, and they now work on a $4000 TRS-80. The other two programs I added myself.

These programs are fully-documented, and you can buy the books locally or from me. I made them work on the TRS-80, and if you buy them from me, I'll make them work for you.

If you're not sure about that, call the number below and get the names of some of the people who've bought all over the world. Then ask them.

These programs cost $99.95 each. (The Cash Journal option on the General Ledger adds another $50.) That gets you the disk, all the instructions you need and my phone number. If you call, we answer all your questions. If your question's tough enough, I'll talk to you personally.

Because I plan to turn that TRS-80 of yours into a serious computer.

THE OSBORNE PROGRAMS

Accounts Payable: invoice-linked, it reports, does checks and links to general ledger.
Accounts Receivable: invoice-linked, it tracks invoices and aging, prints statement and links to general ledger.
General Ledger: handles 1750 transactions each on 200 different accounts. Cash journal option available.
Payroll: figures the pay, does the checks and all the bookkeeping.

AND MY OWN PROGRAMS

Inventory Control: gives immediate readout on any inquiry. It has many existing versions or can be individually tailored.
NEW! Invoicing: linked to accounts receivable. Prints invoices and feeds data into receivables.

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A Not-So-Fast Renumberer for OSI BASIC

Written in BASIC, this utility makes your listings neat and tidy.

John W. Aughey
27384 Lamplighter Lane
Elkhart IN 46514

This article describes a routine that will renumber BASIC programs for the Ohio Scientific BASIC-in-ROM computers. The program itself is written in BASIC and was designed on and for my personal machine, a Challenger C2-4P. However, it has also been tested and found to work without modification on the Challenger C1-P and C2-8P machines. Hence, any OSI computer with BASIC-in-ROM can make use of this renumbering routine. I would like to thank Phil Thornton of Elkhart Computer for providing a Challenger C1-P on which to test the program.

I decided to design this program and write this article for three major reasons. First, I have been the proud owner of my C2-4P for a number of months now and, as a result, have written a sizable library of BASIC programs that I would like to tidy up and expand. Second, I hope to make a few bucks from publishing this article so I can buy more hardware to write more programs that will need to be renumbered. And finally, in a February 1979 letter to the editor (p. 20), E. Morris of Midland, Michigan, said he would not renew his subscription unless there was an article oreinted toward us Ohio Scientific users in the next eleven months. I'm always glad to keep a fellow OSI user happy.

After having used their machines for a reasonable period of time, most OSI users would agree that one significant feature absent from the OSI version of Microsoft BASIC-in-ROM is the ability to renumber an existing program. This is a shortcoming that, until recently, I had managed to circumvent manually by writing programs with large gaps in the statement numbers and renumbering manually from printed listings when the source got too shabby to share with fellow programmers. However, my professionalism (I program operating system software for an Amdahl 470/V5 to support my hobby and family) got to me recently, and I finally decided that if I can renumber by hand, then I should certainly be able to tell the 6502 how to do it by itself.

In the process of collecting ideas for an OSI renumber routine, I read a number of articles by others who have written renumber routines for other systems—some in machine code and others in BASIC, some for 6502 machines and some not. The common foundation for all of these routines is a knowledge of how the BASIC interpreter stores the user's program in memory for execution, and I knew this was the key to designing a renumber routine for OSI's version of BASIC.

OSI's BASIC-in-ROM stores a user's source program starting at decimal location 769 in RAM. Each statement is composed of a four-byte header, followed by the compressed statement and terminated with a single byte of zeros. The four-byte header contains two 2-byte data words. The first word is the address of the next sequential statement, or zeros if this is the last statement in the program. The second word contains the statement number in binary format.

Routine Design

My first attempt at writing a renumber program was designed to renumber only the statements themselves, with no consideration of renumbering GOTOs, GOSUBs, THENs or RUNs embedded in the text of the statements. This was a relatively simple task that involved chaining from one statement to the next and inserting the new binary statement number into the second data word in the header I mentioned before.

The crux of this simple-minded renumberer is contained in lines 32000–32010 of the final version (see the listing). This first attempt at renumbering proved quite useful, but it was still a nuisance to have to go back and manually renumber the GOTOs, etc.

The tricky part comes when you go back and attempt to renumber the internals of the statements. As others who have written renumber routines have found, there is an inconsistency in the way statement numbers are stored. The numbers on the statements themselves are in binary form, but the statement number references in GOTOs, etc., are in ASCII.

Fortunately, the OSI BASIC has the very useful STR$ and ASC functions to aid in the conversion process from binary to ASCII. Luckily, the conversion in the other direction—from ASCII to binary—is not too difficult to perform in BASIC without support functions.

The OSI BASIC, as do most others, uses "tokens" to allow the compression of the BASIC source into a smaller package in memory. The tokens are simply single-byte flags with values in the range of decimal 128–255, beyond the range of valid ASCII codes, which are used to take the place of the BASIC command verbs.

Whenever the BASIC scanner finds a string of characters it recognizes as a keyword, such as GOTO, it replaces that character string with the single-byte token that corresponds to that keyword. The renumber routine must thus scan for the tokens requiring renumbering and alter the statement numbers that follow them. In the OSI version of Microsoft BASIC, the tokens we need to look for are decimal 136 (GOTO), 137 (RUN), 140 (GOSUB) and 160 (THEN).

The renumber routine is organized into two parts. The first part is the "simpleminded" renumberer I described earlier, with one additional function. While it is inserting the new statement numbers, it also must save the old statement numbers in a chunk of RAM so the second pass will know how to renumber the internals of the statements. In OSI systems with video boards, one of the most convenient chunks of RAM is the video display memory, which begins at 53248 decimal. Each statement number saved uses two bytes, and two bytes are required for an end-of-table flag. Hence in the C1-P machines with 1024 bytes of video RAM, you can renumber a program with as many as 511 statements. In the C2-4P you can handle 1023 statements with its 2K of video RAM.

The second part of the renumberer goes back and looks at the text in the state-

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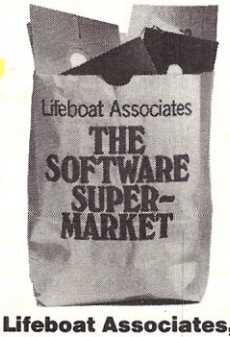

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ments, looking for the four tokens noted earlier. When it finds one of them, it looks behind it to see if there is a statement number. If the routine finds a statement number 1, it converts it from ASCII to binary and then compares it against the statement numbers that the first pass saved in the video RAM.

At this point one of two things can happen to the renumber program. The first is that it finds the old statement number in the table. If this occurs all is OK, and we proceed normally. The alternative is that the routine can't find the old statement number, in which case there was an error in your original source program, such as a GOTO with a missing destination.

Improvisations

But at this point your old program is partially renumbered, and we can't just stop renumbering. So to recover, I chose to insert percent signs (%) where the missing statement number was, to indicate in the renumbered listing that something went wrong during renumbering. It would have been nice to print an error message at this point, but doing so would have disturbed the video RAM where the old statement numbers were stored. I discovered this the hard way after much head scratching!

If the program successfully found the old statement number in the video RAM, it must now insert the corresponding new statement number in the BASIC text in place of the old number. Here is where the STR$ and ASC functions of BASIC come in to play. One minor quirk that must be addressed here is that the STR$ function returns a leading blank in the character string, probably where a sign would go, and this blank should be skipped over when POKEing back the ASCII characters.

At this point we run into another possible error condition. What happens if the new statement number has more digits than the original statement number and, hence, won't fit over top of it? Again, I chose to overlay the old statement number with a special character, in this case the ampersand (&), to flag the error and distinguish this type of error from the "old statement not found" condition noted before.

A few other minor changes are required to make this renumbering technique work. Most important is to make sure that the program doing the renumbering does not try to renumber itself. Strange and undesirable things can happen if a program attempts to dynamically renumber itself. To prevent this from occurring, the renumber program checks for statement numbers greater than 31998 and leaves them alone. Since the renumberer starts at statement 31999, it will remain intact.

Operation

The procedure to use the renumber program is relatively simple. First, load in the renumber program, which starts at statement 31999. Actually, the first executable statement is at 32000; the END at 31999 is inserted to stop a user program that terminates by falling through to the end of the program without an explicit END statement. After loading in the renumbering program, load or key in the program you wish to renumber. It is assumed that this program will not have statement numbers greater than 31998.

After loading is complete, key in RUN 32000 to begin renumbering. You will be prompted for the desired beginning new statement number and increment value. After this, the only visible evidence that renumbering is in process is that some apparently meaningless characters will appear at the top portion of your video monitor during the first renumbering pass: These are the old statement numbers being saved in the video RAM. These may not be visible if you are renumbering a short program on a C1-P system, due to video overscan.

After this there will be a relatively long pause, possibly several minutes, depending on the size of the program being renumbered. Be patient; do not press control-C or BREAK during this period or the program being renumbered will be left only partially renumbered, since the video RAM will be disturbed. When renumbering is completed, BASIC will prompt you with an OK, and you can proceed to list and save your renumbered program. To save or list just your renumbered program and not the renumbering code, key in LIST 1-31998, and any statements in your program will be listed.

The renumberer can be a valuable tool during program development by allowing dynamic renumbering while you are in the process of coding and testing a new program. It gives the added benefit of checking for missing destinations on GOTOs and GOSUBs that might otherwise go undetected until an unusual condition arose in program execution.

The renumberer does not affect the execution of the user program while coexisting with it in the machine, other than by occupying memory that would otherwise be available for variables. The program statements for the renumberer occupy just under 1K bytes, and the requirement for variables during execution will bring the storage requirement up somewhat beyond that.■

```
31999 END
32000 CLEAR:PRINT"START AND INC":INPUTNF,IN
32001 AD=769:SS=53248:SN=NF
32002 SL=PEEK(AD+2):SH=PEEK(AD+3)
32003 POKESS,SL:POKESS+1,SH:SS=SS+2
32004 OS=SL+256*SH
32005 IFOS<31999THEN32007
32006 POKESS,255:POKESS+1,255:GOTO32011
32007 BT=INT(SN/256):POKEAD+3,BT
32008 BT=SN-256*BT:POKEAD+2,BT
32009 AD=PEEK(AD)+256*PEEK(AD+1):SN=SN+IN
32010 IFAD<>0THEN32002
32011 AD=769:MN=SN:SN=NF
32012 BP=AD+4
32013 BT=PEEK(BP)
32014 IFBT=0THEN32020
32015 IFBT=136THEN32023
32016 IFBT=137THEN32023
32017 IFBT=140THEN32023
32018 IFBT=160THEN32023
32019 BP=BP+1:GOTO32013
32020 AD=PEEK(AD)+256*PEEK(AD+1):SN=SN+IN
32021 IFSN<MNTHEN32012
32022 END
32023 BP=BP+1:BT=PEEK(BP)
32024 IFBT=0THEN32020
32025 IFBT=32THEN32023
32026 IFBT=44THEN32023
32027 IFBT<48THEN32014
32028 IFBT>57THEN32014
32029 FC=BP:LC=BP:OS=BT-48
32030 BP=BP+1:BT=PEEK(BP)
32031 IFBT<48THEN32034
32032 IFBT>57THEN32034
32033 OS=OS*10+BT-48:LC=BP:GOTO32030
32034 SS=53248:JS=NF
32035 I=PEEK(SS)+256*PEEK(SS+1)
32036 IFJS>=MNTHEN32039
32037 IFI=OSTHEN32042
32038 SS=SS+2:JS=JS+IN:GOTO32035
32039 JS=37
32040 FORI=FCTOLC:POKEI,JS:NEXTI
32041 GOTO32024
32042 A$=STR$(JS):I=LEN(A$)
32043 IFI>LC-FC+2THENJS=38:GOTO32040
32044 FORI=FCTOLC:POKEI,32:NEXTI
32045 LC=FC+LEN(A$)-2
32046 FORI=FCTOLC
32047 JS=ASC(MID$(A$,I-FC+2,1))
32048 POKEI,JS:NEXTI
32049 GOTO32024
```

Program listing.

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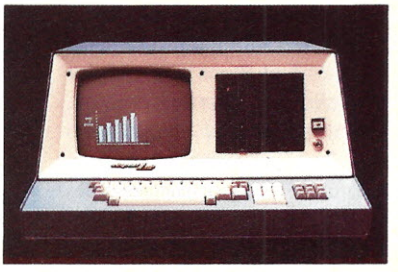

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T34

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Visions of Sacks of Silver Dollars

Teach 'em a thing or two at the casinos with this Blackjack-strategy tutor.

Thomas W. Glaser
RR 1
Rochester MN 55901

Ah . . . Vegas and the glittering casinos filled with row after row of green-felt tables manned by the ever-efficient dealers of Twenty-one gently riffling card decks as they prepare the "shoe." Does there exist a would-be gambler who has not dreamed of making a killing at one of these tables and departing Las Vegas with a bag of some casino's loot?

I had such dreams prior to my first trip to Vegas last year. To enhance my chances for success I looked for ways to sharpen my skills before the big test, as I'm sure others do. I visited the local bookstore and found several books and pamphlets describing various methods of successfully playing these mystical games of chance for profit.

I purchased one of these sources of winning strategy for the game of Blackjack and, for the following several evenings, practiced as best I could making the correct strategic choices from many sample hands. Though the way I practiced didn't seem very efficient, I at least managed to leave Vegas with slightly more greenbacks than I had arrived with (though nothing resembling a bag was needed to carry away my loot).

Recently I was reminded once again of this need for each of us to polish our skills prior to our try at the real thing, and the ideal practice method came clearly into focus. The idea for a computerized Blackjack tutor was born when my friend Ted strolled into my classroom one morning with that gambler's glint in his eyes. In his hands was a copy of the *Rules of Blackjack* and an airline ticket to sunny Nevada some four weeks hence.

Now, Ted is a sly fellow in his own way. He knows of my near fanatical interest in microcomputers and has a good appreciation of their capabilities. So he had come with a not-so-innocent question in mind: "How difficult would it be to create a Blackjack teacher that would deal random hands and then check my ability to make the correct choice?"

Some ideas rather easily arouse my interest, and I had the distinct feeling that Ted knew this idea would fit that category. I had played different versions of Blackjack on several systems, but never one that had provided feedback on correct strategy. If I had only had such a tireless gambling tutor before my venture to Vegas . . . mmm . . . visions of sacks of silver dollars.

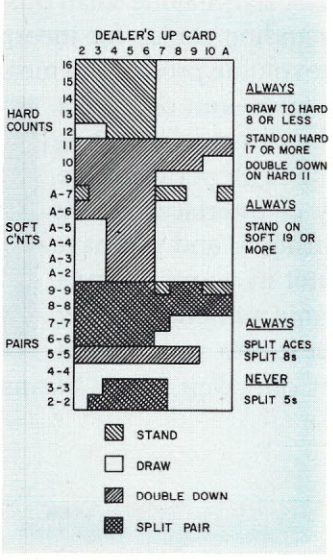


Fig. 1. Basic Blackjack strategy.

Bouyed by the idea that others (especially *Microcomputing* readers) might also benefit from such a teacher, I told Ted his tutor would be ready for some serious practice sessions before his scheduled flight to the Strip.

Blackjack Strategy

There are countless books that describe the rules and basic stategy of the game of Blackjack, or Twenty-one. The object of the game is, of course, for the player to hold a hand that has a count not greater than 21, but greater than the count held by the dealer. It is perhaps the only casino game in which the player exercises judgement and discretion in the play of the cards. Thus, the player's chances of success can be improved considerably by increased knowledge of probabilities and correct strategy.

There are several techniques the player can learn to enhance his playing ability. Some, like counting, are too complicated and require too much practice and concentration for the casual player. The strategy taught by the tutor is condensed from several sources and consists of these simple rules:

1. When the dealer has a small card (2-3-4-5-6), stand on hands of 13-14-15-16. Draw to 12 if the dealer has 2 or 3.

2. When the dealer has a large card (7-8-9-10-ace), draw until a count of 17 or greater is reached.

3. Double down when you have:
Hard 10 except when dealer has 10 or ace
Hard 9 except when dealer has 7 through ace
Hard 11, always
Ace-2 through ace-5 when dealer has 4-5-6
Ace-6 when dealer has 2 through 6
Ace-7 when dealer has 3 through 6

4. Split pairs when you have:
2s when dealer has 3 through 7
3s when dealer has 4 through 7
6s when dealer has 2 through 6
7s when dealer has 2 through 7
9s when dealer has anything but ace-7-10
Always split aces, eights

5. For ace-2 through ace-6, draw a card if not able to double down.

6. When holding ace-7:
Stand if dealer has ace-2-7-8
Double down if dealer has 3-4-5-6
Draw if dealer has 9 or 10

7. Always stand on ace-8, ace-9

These rules are summarized in Fig. 1, which diagrams the correct selections for the possible combinations of two cards held by the player and the visi-

Program listing. SWTP Blackjack tutor.

```
0005 PRINT
0010 PRINT "BLACKJACK STRATEGY TUTOR"
0020 PRINT "VERSION 2-8-79"
0030 LINE= 80
0035 REM CREATE MATRICES
0036 REM P - FOR WHEN PLAYER HAS A PAIR
0037 REM S - FOR WHEN PLAYER HAS A SOFT COUNT (ONE CARD AN ACE)
0038 REM H - FOR WHEN PLAYER HAS A HARD COUNT
0039 REM C$,T$ - FOR DESCRIPTIVE WORDS DURING PLAY
0040 DIM P(10,10),S(8,10),H(8,10),C$(13),T$(4)
0050 PRINT "WOULD YOU LIKE INSTRUCTIONS?"
0060 INPUT I$
0070 IF LEFT$(I$,1)="N" THEN 180
0080 PRINT "YOU AS THE PLAYER WILL BE DEALT BLACKJACK HANDS AND"
0090 PRINT "SHOWN THE DEALER'S UP CARD.  JUST AS AT THE TABLE, YOU"
0100 PRINT "WILL THEN HAVE FOUR OPTIONS:"
0110 PRINT "   STAND PAT    (STAND OR ST)"
0120 PRINT "   SPLIT PAIRS   (SPLIT OR SP)"
0130 PRINT "   DOUBLE DOWN   (DOUBLE OR DO)"
0140 PRINT "   DRAW A CARD   (DRAW OR DR)"
0150 PRINT "THE TUTOR WILL THEN ADVISE YOU IF YOUR ACTION IS"
0160 PRINT "CORRECT BASED UPON BASIC BLACKJACK STRATEGY.  YOU"
0170 PRINT "MAY ENTER  END  AT ANY TIME TO HALT THE EXERCISE."
0180 PRINT "GOOD LUCK...ENTER ANY NUMBER TO BEGIN.."
0190 INPUT I
0192 PRINT
0195 REM SEED THE RANDOM NUMBER GENERATOR
0200 X=RND(I)
0201 REM SET FOR ALLOWING 'OBVIOUS' HANDS
0202 Z=1
0203 PRINT "DO YOU WISH TO BE DEALT HANDS WITH HARD"
0204 PRINT "COUNTS OF 8 OR LESS AND 17 OR MORE?"
0205 INPUT I$
0206 IF LEFT$(I$,1)="Y" GOTO 210
0207 REM SET TO IGNORE OBVIOUS HANDS
0208 Z=2
0209 REM ASSIGN VALUES TO THE MATRICES
0210 FOR J=1 TO 10
0220 FOR I=1 TO 10
0230 READ P(I,J)
0240 IF I<9 READ S(I,J),H(I,J)
0250 NEXT I
0260 NEXT J
0265 REM CORRECT SELECTION TABLES
0266 REM 1=STAND
0267 REM 2=SPLIT
0268 REM 3=DOUBLE
0269 REM 4=DRAW
0270 DATA 2,4,4,4,4,4,4,4,3,4,4,4,4,4,4,4,1,4,4,1,4,2,1,4,1,1
0280 DATA 2,4,3,2,4,3,2,4,3,4,4,4,4,3,3,1,2,1,1,2,1,1,2,1,1,2,1
0290 DATA 2,4,3,2,4,3,2,4,3,4,4,4,4,3,3,1,2,3,1,2,1,1,2,1,1,2,1
0300 DATA 2,3,3,2,3,3,2,3,3,4,3,1,3,3,1,2,3,1,2,1,1,2,1,1,2,1
0310 DATA 2,3,3,2,3,3,2,3,3,2,3,1,3,3,1,2,3,1,2,1,1,2,1,1,2,1
0320 DATA 2,3,3,2,3,3,2,3,3,4,3,1,3,3,1,2,3,1,2,1,1,2,1,1,2,1
0330 DATA 2,4,4,2,4,3,2,4,3,4,4,4,4,3,3,4,4,2,1,4,2,1,4,2,1,1,1
0340 DATA 2,4,4,4,4,4,3,4,4,3,4,4,4,4,3,4,4,4,1,4,2,1,4,2,1,4,2,1
0350 DATA 2,4,4,4,4,4,3,4,4,3,4,4,4,4,3,4,4,4,4,4,4,1,4,2,1,4,2,1
0360 DATA 2,4,4,4,4,4,4,4,4,3,4,4,4,4,4,4,4,4,4,4,1,4,2,1,4,1,1
0370 FOR I=1 TO 13
0380 READ C$(I)
0390 IF I<5 READ T$(I)
0400 NEXT I
0410 DATA "ACE","STAND","DUECE","SPLIT THE PAIR","TREY"
0420 DATA "DOUBLE DOWN","FOUR","DRAW A CARD","FIVE","SIX"
0430 DATA "SEVEN","EIGHT","NINE","TEN","JACK","QUEEN","KING"
0435 REM INITIALIZE HAND (A), CORRECT (C) AND BLACKJACK (B) COUNTERS
0440 A=0
0445 B=0
0450 C=0
0455 REM DEAL THE PLAYERS HAND (P1 AND P2) AND THE DEALERS
0456 REM UP CARD (D)
0460 P1=INT(13*RND+1)
0470 P2=INT(13*RND+1)
0480 D=INT(13*RND+1)
0490 REM DETERMINE THE CORRECT RESPONSE FOR THESE CARDS
0495 REM TREAT ALL FACE CARDS AS 10 COUNT
0500 V1=P1
0502 V2=P2
0504 IF V1>10 THEN V1=10
0506 IF V2>10 THEN V2=10
0508 R=V1+V2
0510 D1=D
0512 IF D1>10 THEN D1=10
0514 IF P1<>P2 GOTO 570
0520 REM PLAYER HAS A PAIR OF LIKE CARDS
0545 REM GET THE CORRECT ACTION FROM THE PAIRS TABLE
0550 Q=P(V1,D1)
0560 GOTO 740
0565 REM CHECK EITHER PLAYER CARD AN ACE
0570 IF P1<>1 THEN IF P2<>1 THEN 670
0575 REM ONE CARD AN ACE, CHECK FOR BLACKJACK
0580 IF P1<10 THEN IF P2<10 THEN 630
0590 REM PLAYER HAS A BLACKJACK!
0600 Q=5
0610 GOTO 740
0620 REM PLAYER HAS A SOFT COUNT (ONE CARD AN ACE)
0625 REM CORRECT TABLE INDEX
0630 R=R-2
0635 REM GET CORRECT RESPONSE FROM SOFT TABLE
0640 Q=S(R,D1)
0650 GOTO 740
0660 REM PLAYER HAS A HARD COUNT (NEITHER CARD AN ACE)
0665 REM IF COUNT>17 OR COUNT<9 THEN OBVIOUS STAND OR DRAW
0670 Q=1
0680 IF R>16 THEN ON Z GOTO 740,460
0690 Q=4
0700 IF R<9 THEN ON Z GOTO 740,460
0705 REM OTHERWISE CORRECT TABLE INDEX
0710 R=R-8
0715 REM AND GET CORRECT RESPONSE FROM HARD TABLE
0720 Q=H(R,D1)
0730 REM PUT THE HAND OUT TO THE TERMINAL
0740 PRINT
0750 PRINT "HERE WE GO SAYS THE DEALER..."
0755 PRINT
0756 PRINT
0760 PRINT "THE DEALERS UP CARD IS ";C$(D)
0770 PRINT
0780 PRINT "YOU HAVE  ";C$(P1);" - ";C$(P2)
0790 PRINT
0800 PRINT
0810 IF Q<>5 GOTO 870
0820 PRINT "YOU HAVE A BLACKJACK!!  NO SELECTION IS NEEDED."
0825 B=B+1
0830 PRINT "PRESS RETURN FOR NEXT HAND.."
0835 A=A+1
0840 INPUT I$
0850 IF I$="END" GOTO 1140
0860 GOTO 460
0870 PRINT "IT'S UP TO YOU..."
0880 PRINT "YOUR CHOICE? SAYS THE DEALER..."
0890 INPUT I$
0895 REM GET INDEX OF PLAYERS RESPONSE
0900 R$=LEFT$(I$,2)
0905 IF R$="EN" GOTO 1140
0910 FOR I=1 TO 4
0920 IF R$=LEFT$(T$(I),2) GOTO 970
0930 NEXT I
0940 PRINT I$;" IS AN INVALID RESPONSE"
0950 PRINT "HERE'S THE HAND AGAIN"
0960 GOTO 755
0970 IF I<>Q GOTO 1060
0974 C=C+1
0975 REM THE PLAYER HAS CHOSEN CORRECTLY
0980 X=INT(3*RND+1)
0990 ON X GOTO 1000,1020,1040
1000 PRINT "VERY GOOD...CORRECT RESPONSE.."
1010 GOTO 830
1020 PRINT "EXCELLENT.  CORRECT CHOICE..."
1030 GOTO 830
1040 PRINT "THE DEALER SMILES KNOWINGLY AT YOUR WISDOM..."
1050 GOTO 830
1055 REM THE PLAYER HAS CHOSEN INCORRECTLY
1060 X=INT(3*RND+1)
1070 ON X GOTO 1080,1100,1120
1080 PRINT "NO, THE CORRECT ACTION IS ";T$(Q)
1090 GOTO 830
1100 PRINT "BREAK TIME...";T$(Q);" IS THE CORRECT CHOICE.."
1110 GOTO 830
1120 PRINT "THE DEALER FROWNS...HE EXPECTED YOU TO ";T$(Q)
1130 GOTO 830
1135 REM END SELECTED, PRINT ATTEMPTS,CORRECT COUNTS
1140 PRINT
1144 PRINT "YOU HAVE PLAYED ";A;"HANDS.  YOU HAVE CHOSEN THE"
1150 PRINT "CORRECT PLAY ";C;"TIMES AND HAD ";B;"BLACKJACKS."
1160 PRINT "TRY AGAIN SOON..."
1170 END
```

ble card held by the dealer. Use of this strategy will allow the player to give the casino a good, stiff battle in Blackjack. In fact, use of this strategy will cut the house percentage to less than one percent, an almost even money bet.

You must believe, though, that the actions indicated by these rules are absolutely correct. Selections other than those shown in Fig. 1 will only lessen the player's probable success. This, then, is the strategy upon which the tutor will rely in its determination of the correct choice for each hand dealt to the player.

How the Tutor Works

The Blackjack tutor is set up to generate random practice hands of Blackjack and test the player's ability to make the correct strategic choice for the hand. In the play of a given hand, the tutor generates three random cards—two for the player and a third for the dealer. Based upon the values of these cards, the tutor determines the correct action from a table based on the strategy outlined above.

If the player has a Blackjack (an ace and a ten-count card), the hand is over. The tutor assumes that any would-be player of Blackjack will know what one is and know not to draw to it! For player hands other than Blackjack, the tutor will ask for the player to select an action. The player has four choices:

1. Draw a card (enter draw or dr)
2. Stand pat (enter stand or st)
3. Split pair (enter split or sp)
4. Double down (enter double or do)

The player's choice is compared to the correct action the tutor expects, and an appropriate congratulations or condolence message is printed. If the

player chooses incorrectly, the tutor will also advise the player what the correct action is for the hand. This allows the player to immediately correct his thinking for the conditions displayed and is the one item that sets the Blackjack tutor apart from other computer Blackjack games.

The Tutor Program

The Blackjack tutor is written in SWTP 8K BASIC Version 2.0, but is written to be easily adaptable to other versions of BASIC. I used only single statements per line and also avoided unusual statement types as much as possible.

The program is well commented and thus self-explanatory. To conserve memory or avoid keying, all line references are structured such that all REM (remark) statements can be removed without affecting the operation of the program. However, this alone will not allow the program to run on a 12K system; 16K is the minimum system required. If operation on a 12K system is required, elimination of lines 980–1030, 1070–1110 and possibly the instructions will be necessary.

In addition to the basic program operation described above, there are a couple of additional significant features. As a player uses the tutor and becomes more practiced, some hands become old hat. Among these are hands with hard counts of 8 or less or 17 or more. The correct action for these hands is pretty obvious, even for the beginner. At this point, the player might wish to concentrate his practice on hands that are not quite so obvious. The tutor allows the player to select this option before the play begins.

The tutor will also keep a running total of the number of hands played, the number of correct choices made by the player and the number of Blackjacks dealt to the player. When END is entered by the player to end the session, a summary of these counts will be printed.

Final Comments

After completing the BASIC version of the Blackjack tutor, I also wrote a version in 6502 assembler for the KIM-1. This program occupies about 700 bytes of RAM and uses the KIM's keypad and display for input/output. The entries and displays are not nearly so elegant as in the BASIC version, but the strategy taught is identical. Thus, its usefulness as a learning tool for the game of Blackjack is no less than that of its bigger brother.

I will provide an object code listing and description of operation to interested persons for the cost of mailing and reproduction. My friend Ted, in fact, has used the KIM version as one of his prime practice tools. And as for Ted, well, he's yet to hit the felt tables, but after all of his tutor-guided practice, he has visions of sacks of silver dollars.■

```
BLACKJACK STRATEGY TUTOR
VERSION 2-8-79
WOULD YOU LIKE INSTRUCTIONS?
? NO

GOOD LUCK...ENTER ANY NUMBER TO BEGIN..
? 1

DO YOU WISH TO BE DEALT HANDS WITH HARD
COUNTS OF 8 OR LESS AND 17 OR MORE?
? NO

HERE WE GO SAYS THE DEALER...

THE DEALERS UP CARD IS JACK

YOU HAVE  KING - DUECE

IT'S UP TO YOU...
YOUR CHOICE? SAYS THE DEALER...
? DRAW

EXCELLENT.  CORRECT CHOICE...
PRESS RETURN FOR NEXT HAND..
?

HERE WE GO SAYS THE DEALER...

THE DEALERS UP CARD IS FIVE

YOU HAVE  NINE - SIX

IT'S UP TO YOU...
YOUR CHOICE? SAYS THE DEALER...
? STAND

VERY GOOD...CORRECT RESPONSE..
PRESS RETURN FOR NEXT HAND..
?

HERE WE GO SAYS THE DEALER...

THE DEALERS UP CARD IS FOUR

YOU HAVE  SEVEN - TREY

IT'S UP TO YOU...
YOUR CHOICE? SAYS THE DEALER...
? DRAW

THE DEALER FROWNS...HE EXPECTED YOU TO DOUBLE DOWN
PRESS RETURN FOR NEXT HAND..
? END


YOU HAVE PLAYED 3 HANDS.  YOU HAVE CHOSEN THE
CORRECT PLAY 2 TIMES AND HAD 0 BLACKJACKS.
TRY AGAIN SOON...
```

Sample run.

EXATRON STRINGY FLOPPY
Owners Association Newsletter

Secretary, Fred Waters

THE EXATRON STRINGY FLOPPY

For new readers, the ESF is a mass storage subsystem for microcomputers. Because of its speed and reliability, it does away with all the objections of using audio tape, and audio recording and playback techniques, without going to the expense of acquiring disk subsystems. The ESF is available for the TRS-80, SWTP or other 6800 systems, and S-100 bus systems. The TRS-80 version is a complete unit, ready to plug in and go, and as simple to use as the TRS-80 itself. It will load a 4K program in 6 seconds without error, and can save up to 40K on the longer tapes. Use our toll-free line below to ask for the information packet on the ESF.

ESF WORKSHOP

You would have been amazed to see what went on at a recent Saturday morning ESFOA workshop. Present was a wide range of Exatron Stringy Floppy owners and enthusiasts: professional programmers, gifted amateurs, beginners in microcomputing, and some brand new ESF owners. Several encouraging wives were there. After exchanging information on what each owner was doing, and questions and answers, there were several demonstrations of new programs and projects. One new owner showed us "WORM", a fascinating little graphics program with a worm wiggling his way all around the screen at random. Another had prepared his family and friends for Halloween by writing an interactive program with graphics and story line–scary face, startling displays, humorous dialog, and all! Others had intensively exercised the new data I/O functions (see below) for the TRS-80 version of the ESF, and had comments on the fine points of using data files. Long after the normal end of the meeting, the plant office and conference area was still full, with guys who didn't know learning from guys who did, with more detailed exchanges on individual projects, and with discussion of what to do next.

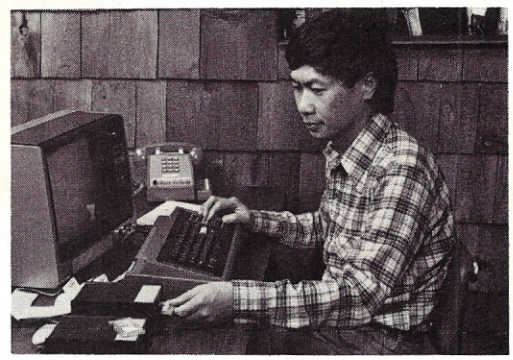
ESFOA CHAPTERS ALL OVER

Well, you can do it too! We've had a number of inquiries from ESF owners around the US about other owners nearby. As the nationwide density of owners increases, clusters grow in the more populated areas. So we have a plan under way to get you together, to inform you of nearby colleagues. Then you too will have the benefits of meeting and exchanging information on techniques, programs, new applications and hardware augmentations.

HANDLING DATA FILES

Along with the firmware built in the ESF, you also get another significant piece of software–the Data I/O Program for the TRS-80 version, on ESF wafer. The ROM has the programs for certifying new wafers, and for saving and loading BASIC and assembly language programs. The subroutines needed for data file handling are also in the ROM, and assembly language programmers can use them. Those who prefer BASIC can use the Data I/O Program. It resides in RAM, and is delivered on ESF wafer with your system.

Well, what does it do? Those of you who have fooled with larger computers or have used disks probably already know. Let's look at an example. Say you have a household or small business inventory program in your TRS-80. The program has provision for entering items and related data, for reporting quantities, for flagging recorder reorder points, for processing cost and price data, and so forth. So you take an inventory as of January 1. Now all the data you have in the file–the raw material on which your program operates, and which changes periodically–needs to be retained until the next inventory. At that time the present data is the starting point for the changes that have occurred. So you need to save the data on your storage medium, ready to process the next time you use the program.



Dr. Lichen Wang is a physicist who learned programming simply to make his job easier. Dr. Wang has authored several highly significant software systems for personal computers. His first popular and famous program was the kaleidoscope program for the Cromemco dazzler video board. Dr. Wang is the author of Palo Alto Tiny Basic which appeared later in an expanded version as Cromemco Control Basic and was also used as the basis for TRS-80 Level I Basic. Dr. Wang wrote a robot control language called "WSFN" [Which Stands For Nothing] that can drive x-y access devices and uses very unique concepts to allow reiterative shorthand code to draw repetitive shapes. Most of the prolific output of Dr. Wang has been given away and freely published for use and modification by hobbyists.

The syntax for the Data I/O Program provides first for OPENing a numbered file on a selected drive unit. Up to eight Stringy Floppys can be operated with one TRS-80, and there can be up to 99 files on one wafer. You may open one file on each drive unit in your system, if needed. Next you use the command "@PRINT", following by a list of expressions (constants, variables and operators) to save on tape the values of the selected expressions. Finally you use the "@CLOSE" command to close the file. For multi-drive systems there is provision for designating the current drive, for closing all open files at once, and for clearing all variables and arrays.

When you want to retrieve the data, you again use the "@OPENn" command (n is the file number), and then load the data by using the "@INPUT" command, followed by a list of variables. These variables must match in type the expressions saved, and their values are loaded into memory. Again you must close the file, and you may select another drive unit or clear all variables and arrays as before.

An important point: all the commands for data I/O can be used as program statements, just as the commands for loading BASIC and assembly language programs can. This means that you can write your BASIC program to include the functions both of creating and processing the data you are interested in, and of storing it on a data file wafer until needed again. You can probably think of–or already have thought of–many applications around the home or in a small business where you need data files.

In passing: probably the most important single conceptual feature of the Exatron Stringy Floppy is its total adaptability to any software capability you can imagine. If you need a particular microcomputer application, and if a program can be written to carry it out, the ESF can handle it for you.

INFORMATION & ORDERS

The ESF is assembled and tested at the factory, with a 30-day moneyback guarantee and a one-year full warranty. Base price for the TRS-80 ESF: $249.50. For the S-100 ESF: $289.50. For SWTP: $250.00. Place credit card or COD orders using the toll-free line below for fastest delivery.

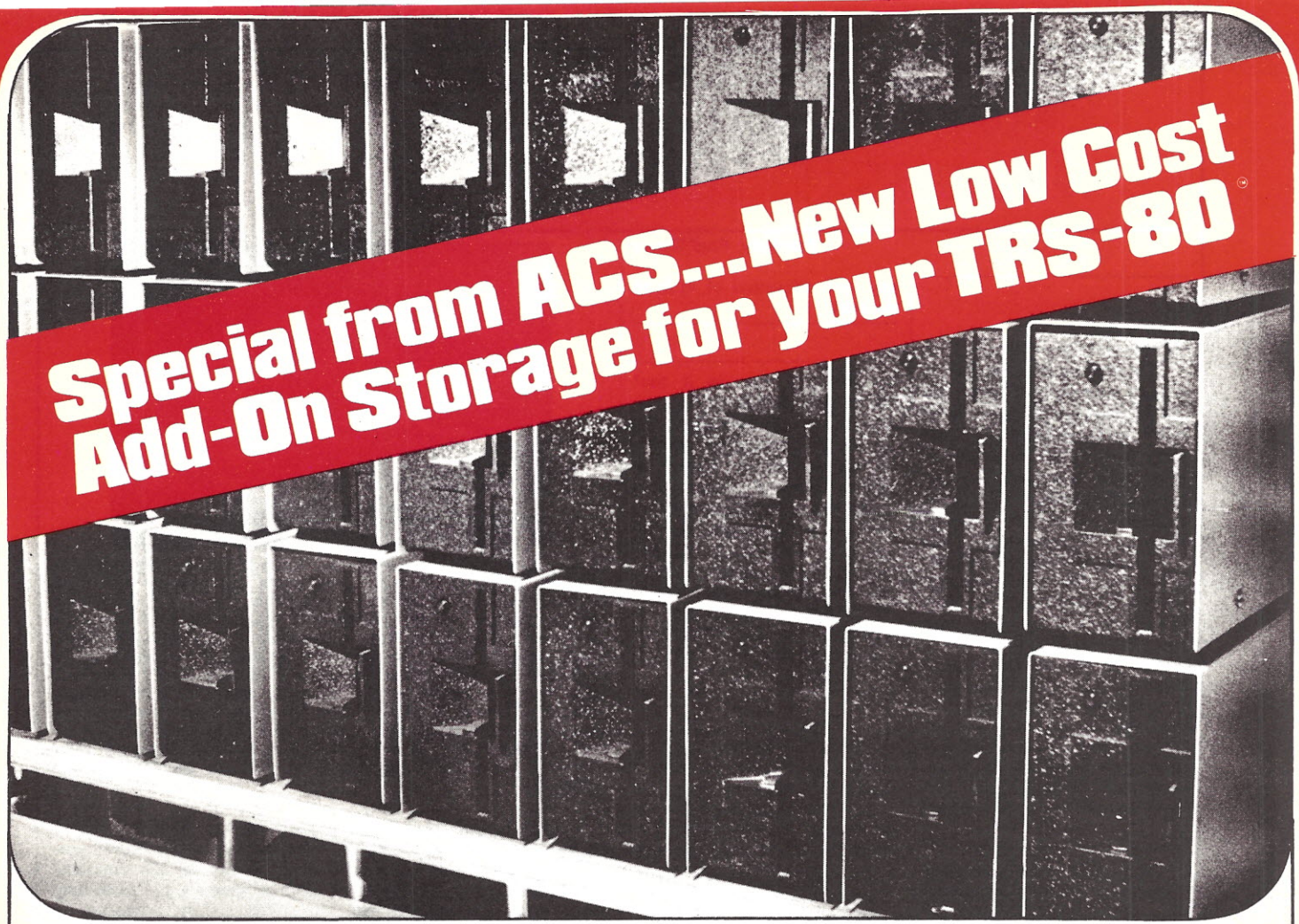
User's Manuals and a complete information packet is available for all versions of the ESF at no charge.

If you have any questions about these products, about Exatron, or about ESFOA, call the Hot Line. Address letters to ESFOA, 3559 Ryder St., Santa Clara, CA 95051.

E48

HOT LINE **800-538-8559**

WITHIN CALIFORNIA **408-737-7111**



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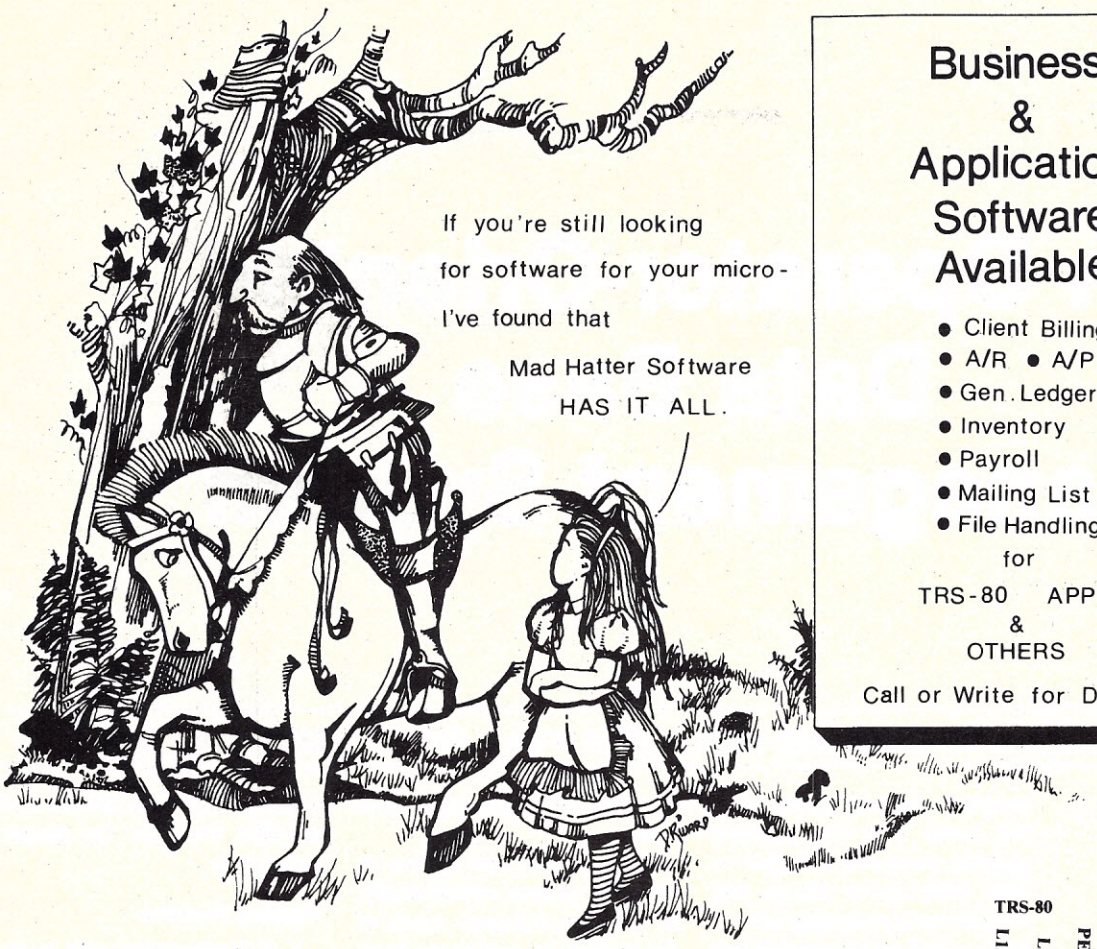

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An Operator-Oriented Data Base Management System

This three-part article on managing data begins with a description of the system.

Joel Shapiro
491 Kenilworth Court
Des Plaines IL 60016

It all started when I decided I needed another program that could generate some new files for storing catalog data. Going back through the many applications programs I had written in the past, I was amazed at the number of different file formats I had generated for my programs. As anything less than standardization is unforgivable in my profession (manufacturing), I decided to do something about it.

Introduction

The computer at home is used for a part-time computer service run by my wife and as a tool with which I can develop business software. A data base management system would be helpful for both uses. Considering my wife's background in office procedure (former secretary and word-processing department supervisor), I could make the program compatible with the manual systems used in many small businesses.

The problem I've run into in the past is that many existing programs support a long learning curve from the operator training viewpoint. The unfortunate thing about this is that most small businesses will not use a computer if it won't fit into their existing procedures with a minimum of effort and change. Anticipating this and the fact that many readers would like this type of program, I decided to incorporate many prompts and error-trapping routines in the program.

As a businessman with some years of experience as a manufacturing executive, I am familiar with data base systems from the user's viewpoint. This has helped in developing this program in that many of the features of some existing commercial programs are not used and other features are desired.

I have selfishly written the program with my own prejudices in mind, and I believe an operator, with very little training, can make use of the system. No attempt has been made to conserve memory or increase speed at the expense of operator convenience, operator assistance or system flexibility. The compromise in speed is not limiting for personal computer use and is within the requirements of a small business that will use the computer to supplement a small staff.

The program was written to run in my system, which has 48K of memory. Although much of the memory is used by the interpreter and approximately 2K is used for the display at the top end, it has proved to be enough for the program. The system also has dual disk drives, each capable of 315K of storage, and a printer capable of 132 characters per line. I feel that this may represent the system a small business would use.

The programs can be changed to suit individual systems by use of the chain feature of Micropolis BASIC for smaller program segments. The elimination of many of the prompts, error traps, messages and remarks can also save memory, but this may compromise operator convenience and promote error. Additionally, a few of the subroutines will have to be changed to suit the user's terminal. Those written in the program support a Merlin video board, which is not too common.

Part 1 of this three-part article will describe the features and operations of the program, leaving the description of the code itself for parts 2 and 3. I will cover explanations of features used in Micropolis BASIC and possible changes the reader may desire.

Program Features

1. Full prompting, with many error traps, error messages and subroutines, which make it easy to learn.
2. Up to 30 fields for data, each of any length as long as the total of all fields does not exceed 248 characters.
3. Field titles up to 18 characters.
4. Complete edit function for all data.
5. Data can be deleted from one file and added to another automatically.
6. Automatic formatting of dates.
7. Automatic search for any entry in any field.
8. Automatic formatting of dollar fields.
9. Data recovery utility program for use in case of program crashes.
10. File parameters remain on disk and can be changed by the user.
11. Report format is selected by the user, including all elements of the heading.
12. Report format can be retained on disk for future use as well.

13. Column spacing is automatic, and program will wrap around any lines that are too long for the printer in use.

14. As an option, program will reverse first and last names.

15. Reports can be made any length.

16. Reports can be made with data between an upper and lower limit as determined by the user.

17. Numerical and dollar fields can be totaled at the end of the report.

18. Multiple level sorting that can sort up to ten levels is available. Index files that allow the same file to be sorted in many ways are used.

Description

The data base management system consists of three major programs or functions: one creates a file; another allows the management of data; and the third provides a printed report derived from the data. Other programs in the system provide utility functions such as sorting, and still others provide for the access of data from many files in order to obtain information for a single report. Application programs can gather data from one or several files, manipulate the data and generate reports or even more files. The possibilities are endless when the application calls for the storage and manipulation of data.

The reason the data base management system can have such unique possibilities is that all files are accessed and read in the same manner, so programs can be written with this standardization in mind.

The system presented here covers the three major functions and provides for sorting and file recovery in case of a program crash.

First of all, line 80 is the effective entry point in each program. This means that typing GOTO80 in the case of a program crash will allow reentry into the program and restart without loss of data in most cases. If the computer flashes a FILE OPEN error, just type CLOSE 1 and then GOTO80. A CONTROL C will interrupt processing. The program disk must be placed in drive number 0 for proper chaining operations.

Creating A File

The disk used for this file must have been previously formatted by the Micropolis formatting routines before a file can be created.

Operation is initiated by loading the DATABASE program. When started, the program will request the date and transfer control to PROGRAMS. All programs have a subroutine that will format the date, and all will accept input in the following manner.

When a date is requested, it must be entered month, day and year. It can be entered using single digits for month and day and any nonnumeric character between the groups. This means that 7 3 75 will be formatted as 07/03/75. If you type 7r3z75, it will be formatted properly as well. It is important that all dates be in the same format for proper handling in these programs.

PROGRAMS will display a menu from which the operator can choose the desired function or program, and once chosen, control will be passed to that program. Since data is passed between programs, it is impor-

```
FILE FACTORY     PAYROLL     FILE CODE 1
FILE CREATED 07/05/79     FILE UPDATED 07/29/79      14 ENTRIES

CL #   NAME                              STREET                          CITY                ST  ZIP    DEPT  POSITION
   LG  HR/PAY      SOC SEC #      EXMT  DATE HIRE  DATE DEPT  STATUS  EMER PH       EMP PH        VAC  NAME EMERGENCY

12111  ABBOTT, GEORGE                    345 LENDER AVE                  MATOON              IL  62332  123   INSPECTOR
   12  $    7.54   888-77-6666    1     04/31/76   04/31/76   1       132-1321      132-1321      1    ABBOTT, DORIS

02111  BROWN, GEORGE                     99 DENVER AVE                   ALBION              IL  67766  245   INSPECTOR
   11  $    6.93   131-31-3113    6     06/03/74   07/07/78   2       343-3232      343-3232      4    BROWN, ESTHER J.

10222  BROWN, MARYANN E.                 678 N. MARINE DR.               CHICAGO             IL  60606  300   CLERICAL
   11  $    6.50   303-03-3030    1     06/07/78   06/07/78   1       123-9876      123-9876      0    BROWN, ESTHER

22021  BROWNE, KAREN J.                  19 WOODDALE AVE                 CANOGA              IL  66600  123   SUPERVISOR
   12  $    7.75   535-53-3535    2     01/21/72   01/21/79   1       333-3333      333-3333      1    BROWNE, JOHN

32113  HUDSON, DANIEL J.                 55 NORTH AVE                    CHICAGO             IL  60789  123   BOSS
   23  $   25.00   444-66-8888    2     04/04/69   06/07/78   1       355-6879      355-6879      4    HUDSON, JANE

00122  JOHNSON, JAMES C.                 8954 WOODVILLE AVE              DEMPSEY             IL  61123  105   MACH. OPERATOR
    9  $    5.50   222-33-4444    3     06/15/76   06/15/76   1       444-5555      444-5555      1    WOODS, DORIS

00101  JONES, KEITH                      999 WEST DRIVE                  SAMPSON             IA  23999  111   SALESMAN
   23  $   13.50   999-99-9999    4     05/12/66   05/05/78   1       222-1122      222-1122      4    JONES, BETTY

54321  METZ, GLADYS G.                   54 WINDSON LANE                 CRETE               IL  61134  112   OFFICE CLERICAL
   10  $    5.80   866-54-9002    1     05/13/76   12/12/78   1       662-4578      566-1221      2    METZ, JOHN

00121  PASTERNACK, LAWRENCE              23 PANSY LANE                   ODESSA              IL  60111  105   JR. OPERATOR
    8  $    5.25   444-56-1234    1     07/07/77   08/01/78   1       NONE          234-2345      0    NONE

11056  PETERSON, GERALD                  886 FORMOST DR.                 WINNEBAGO           IN  47768  116   OFFICE CLERICAL
   10  $    5.80   234-76-9456    1     09/21/78   08/21/78   1       555-3456      555-3456      0    PETERSON, HAROLD

00123  SMITH, ROGER                      345 WOOD AVE                    ASPEN               IL  60894  103   MACHINIST
   13  $    8.45   111-22-3333    5     05/06/73   06/22/75   1       234-5678      234-5678      2    SMITH, BETTY

00111  VALDEZ, JUAN                      134 E. 54TH ST                  AKRON               IL  60923  103   MACHINIST
   12  $    7.93   102-23-5678    2     05/12/75   08/19/77   1       335-6789      335-6789      2    VALDEZ, GLORIA

10987  WYNN, EDWARD G.                   244 LAMPSON DR.                 CLARK               IL  61138  124   MANAGER
   41  $   50.00   111-55-7777    4     04/31/67   03/31/78   1       666-9944      666-9944      5    WYNN, BERTHA

TOTAL HR/PAY = $         155.95
```

Listing 1. Entire file—alphabetical sort.

```
FILE FACTORY     PAYROLL     FILE CODE 1
FILE CREATED 07/05/79     FILE UPDATED 07/29/79     14 ENTRIES

NAME                        STREET                  CITY          ST  ZIP

GEORGE ABBOTT               345 LENDER AVE          MATOON        IL  62332
GEORGE BROWN                99 DENVER AVE           ALBION        IL  67766
MARYANN E. BROWN            678 N. MARINE DR.       CHICAGO       IL  60606
KAREN J. BROWNE             19 WOODDALE AVE         CANOGA        IL  66600
DANIEL J. HUDSON            55 NORTH AVE            CHICAGO       IL  60789
JAMES C. JOHNSON            8954 WOODVILLE AVE      DEMPSEY       IL  61123
KEITH JONES                 999 WEST DRIVE          SAMPSON       IA  23999
GLADYS G. METZ              54 WINDSON LANE         CRETE         IL  61134
LAWRENCE PASTERNACK         23 PANSY LANE           ODESSA        IL  60111
GERALD PETERSON             886 FORMOST DR.         WINNEBAGO     IN  47768
ROGER SMITH                 345 WOOD AVE            ASPEN         IL  60894
JUAN VALDEZ                 134 E. 54TH ST          AKRON         IL  60923
EDWARD G. WYNN              244 LAMPSON DR.         CLARK         IL  61138
```

Listing 2. Address list name sort.

tant that DATABASE be the first program used.

The CREATE program provides all of the functions required for creating the file itself, the parameters of which are written into the first five records of the file. Information written into the file by this program is as follows:

File code—I use a numerical code (0-99) to control file access by application programs. It can be alphanumeric and up to 30 characters long if desired.

Special filename/purpose—A string of up to 30 characters—used on reports if actual filename is to be guarded or if purpose such as Payroll, Mail List, etc., is to be printed on the report.

Number of fields—Added by program when file is created.

File create date—Date entered when program was initialized and CREATE program used to create a file.

All of this data is written into record 1 of the file. Additional information such as print options, records to be deleted, file updates, etc., which are used elsewhere in the system, will also be retained in record 1. This saves time in reentering a lot of data and also provides continuity to the system.

The title, size, type code and operator access key for each field is written into records 2-4.

Fields—A field is where a single element of data is stored. The data is accessed from the file by accessing the field. If you picture a printed report with several columns, each column will represent a separate field.

Each field must have a title; a maximum of 18 characters is allowed for each title. Certain features, which are described later, are keyed into a portion of the title, so the title for the field must be decided carefully.

When data is entered into a field, blanks are added to fill out the data string to the selected field length. This is done so the field data can be accessed correctly in all routines. The field codes (N, S and D, meaning numerical, string and dollar, respectively) determine how this is done. All S fields are padded from the right so all string data is left justified when printed. All N fields are padded from the left and are right justified. D fields are padded from the right, but are formatted in the REPORT program.

It is extremely important that the size of a D field allow for the the decimal point and 1/100s (cents) in addition to the space required for whole dollars. No space need be allotted for a dollar sign or commas, as these will be added in the REPORT program.

If a decimal point is used in N fields, don't expect them to line up in printed reports. Because the number of digits to the right of the decimal point is not always known, the field cannot be readily formatted. However, data consisting of a whole number will be right justified.

Certain features are keyed from the first four characters of a field title. When read as *name*, the field is designated as S, and subsequent programs will allow reversal of the first and last names. Names should be entered as follows for correct processing: enter the last name, comma, space and first name. The program will search the string for the comma and reverse the string from that point.

When read as *date*, all programs will provide for correct formatting of the date string. All dates must be in a date field for proper handling of the data.

When the first four characters are read as AMT., the field is set as a D field. If you don't want to use AMT. in the title, it is still possible to designate the field as a D field. Correct formatting will not occur if the field is not coded D.

File Maintenance

The file maintenance program, MAINT, is responsible for controlling data entry, editing and removal with regard to the file. When MAINT is called by DATABASE, a menu to allow selection of one of its many functions will be displayed.

After a filename is given, the program causes the computer to search for the file. In a multiple drive system such as mine, drive 0 is checked first, and if the file has not been found, drive 1 is checked. If the file is not found on either drive, then an error message is displayed. When the file is found, the first five records are read and some of the information is displayed on the screen. The operator can then add data, delete, modify (edit), search and review the file entries as desired. The file is updated as each record is modified or added.

An auto delete function will allow deletion coding of all records in which the entries within a selected field are between upper and lower limits as selected by the operator. This does save considerable time whenever a group of entries are to be deleted.

Note at this time that the records are only coded for deletion. When so coded, they will not be displayed, printed or used in other programs except SORTFILE. Records coded for deletion, however, can have the coding removed within the modify function of the MAINT program. The program was written this way because restacking the file (which removes the coded data) does take considerable time. This is something you may wish to do when you have it, or when you need the file space.

The DELETE program has the responsibility for this function. DELETE is chained from MAINT and is considered part of the MAINT program. When the data has been deleted and the file restacked, any unused tracks are reallocated as open tracks.

Options available in the program include transferring coded data to another file or just deleting the data.

In the case of deleting to another file, the file parameters must be the same in both files; the only difference can be in the filename. For this reason, the utility routine in the CREATE program, which duplicates the file parameters, should be used. Coded records transferred to the file before deletion will be added in sequential order and in the order in which they are transferred. The main reason for transferring to another file is to allow deletion of data from active files and storage of this data for historical reference.

Sorting

The SORTFILE program is capable of multiple-level sorting. This means that it has the capability of sorting into major categories and minor categories, each within the other. For instance, with a mailing list file you can first sort by state, then zip code within a state, town within a zip code and street within a town.

When the program is called, it

will request the primary sort field (which should be a major category) and the subsequent minor fields. Up to ten levels can be sorted in this fashion. Take care in choosing the primary field. If name is a primary field in a sort of many levels, there will be no apparent sort unless many John Smiths are in the file.

Sorting takes time! The more levels selected, the more fields in the file, the more data to sort and the longer it takes. In my tests, 100 entries in a four field, two level sort took 7 1/2 minutes. Nine hundred entries in the same file took 1 1/2 hours.

As sorting takes place the screen will show a descending progression of numbers. This is only to show the operation of the program and the progress of the sorting task. The closer to zero, the closer it is to completion.

When the file has been sorted, the locations of the sorted entries in the master file are located in an index file. The index file stores data in a different format than do the data files. Index information for 1200 file records can be stored in only three tracks of index file. In most cases, this will permit you to store a master file and one or several index files on a single disk.

Up to 1160 data entries and one index file can be placed on a disk. The maximum number of data records allowable, using a full disk, can only be 1211, so the sacrifice of 51 data entries may be warranted in keeping the files together. Don't worry about it!

After sorting, if the program determines there is not enough space on the disk for the index file, it will advise the operator. A new index file can then be created within the program without the loss of the stored data. It is best to create (name) the index file before starting the sort, but it can be done the other way around. The index file can be located on another drive without hampering system operation.

No data is changed in the sorting process, and the master file is not changed. Many index files can be made for the same master file depending upon the sorting requirements.

Remember: All file data is considered in the sort. If data is added or deleted to or from the master file, the file will have to be resorted. If the data is modified in one of the fields used in the sort, the file must be resorted. It is therefore best to make any changes before sorting.

The Report Generator

The REPORT and PRINTER programs produce the printed report in one of several different formats selected by the operator. I used a kind of "salad bar" approach in that the report parameters and features are all operator selected, mainly by answering yes- and no-type questions.

One of the pet peeves of a business executive is that he can't get the report he wants without waiting several weeks for priority in a data processing department. That has been expressed to me upon several occasions at various trade meetings and seminars. A good case for the micro!

It is unfortunate because in some large businesses that have large computers, large sums of money can be lost if the file information isn't available. The impact of the same problem on a small business can sometimes be disastrous.

Have no fear! I believe this approach to getting the information from the files requires very little training and can be used by the person requiring the report without a problem and, I hope, without a loss.

When REPORT is called, the file accessed and the parameters displayed, the operator is requested to enter the fields (by number) wanted in the report and in the desired sequence. Only the fields requested by the operator will be printed. If all fields are to be printed, just enter ALL, and the fields will be printed in file sequence. If the letter T is entered directly after the field number, when the field is an N or D field, the total amount for all entries with that field will be printed at the end of the report.

The operator is then requested to select other options, mainly about the report heading. The field selection, options selected and fields selected for totals are normally retained in the file. After the report is printed, the operator can have this done by selecting the option. This way, the information need not be entered again unless there are changes. It is also possible to generate a report with a different setup without destroying the options already recorded in the file.

After field and option selection, the operator is asked to insert a new line width if different from the 132 character default assignment. This permits the use of different width paper without difficulty.

If a name field is to be printed, the operator is asked if the first and last names are to be reversed. Remember, they are last name first in the file.

The final feature for selection is the determination of upper and lower limits for data in the report. The default of this option is to print all entries. Use of the limit feature permits the operator to select a field to use for the control and to set the limits within that field.

It is therefore a simple matter, for instance, to select a date billed field and print out only the entries with billing between 90 and 120 days old, printing out the outstanding balance as well! This feature works along with the sort so the information is printed in sorted fashion and within the selected limits.

The sorting and the limit routines will work even though the fields used for either or both of them are *not* used in the report. As you can see, the flexibility offered to the operator is tremendous in that a report may be printed in a manner tailored for his needs. The versatility of the system is further demonstrated in the sample runs. To assist in demonstrating the system, I created a short file that resembles what might be considered the payroll data file for a small business.

In Listing 1, the file is printed in its entirety alphabetically. Note that when the number of

```
FILE FACTORY     PAYROLL     FILE CODE 1
FILE CREATED 07/05/79     FILE UPDATED 07/29/79      14 ENTRIES

NAME                                DATE HIRE

KEITH JONES                         05/12/66
EDWARD G. WYNN                      04/31/67
DANIEL J. HUDSON                    04/04/69
KAREN J. BROWNE                     01/21/72
ROGER SMITH                         05/06/73
GEORGE BROWN                        06/03/74
JUAN VALDEZ                         05/12/75
GEORGE ABBOTT                       04/31/76
GLADYS G. METZ                      05/13/76
JAMES C. JOHNSON                    06/15/76
LAWRENCE PASTERNACK                 07/07/77
MARYANN E. BROWN                    06/07/78
GERALD PETERSON                     09/21/78
```

Listing 3. Seniority list.

```
FILE FACTORY     PAYROLL     FILE CODE 1
FILE CREATED 07/05/79     FILE UPDATED 07/29/79      14 ENTRIES

DEPT  HR/PAY      LG  DATE HIRE  EMER PH

103   $   7.93   12  05/12/75   335-6789
103   $   8.45   13  05/06/73   234-5678
105   $   5.25    8  07/07/77   NONE
105   $   5.50    9  06/15/76   444-5555
111   $  13.50   23  05/12/66   222-1122
112   $   5.80   10  05/13/76   662-4578
116   $   5.80   10  09/21/78   555-3456
123   $   7.54   12  04/31/76   132-1321
123   $   7.75   12  01/21/72   333-3333
123   $  25.00   23  04/04/69   355-6879
124   $  50.00   41  04/31/67   666-9944
245   $   6.93   11  06/03/74   343-3232
300   $   6.50   11  06/07/78   123-9876

TOTAL HR/PAY = $        155.95
```

Listing 4. Sort by department.

```
FILE FACTORY      PAYROLL      FILE CODE 1
FILE CREATED 07/05/79      FILE UPDATED 07/29/79      14 ENTRIES

NAME                          DEPT   EMER PH

ABBOTT, GEORGE                123    132-1321
BROWN, GEORGE                 245    343-3232
BROWN, MARYANN E.             300    123-9876
BROWNE, KAREN J.              123    333-3333
HUDSON, DANIEL J.             123    355-6879
JOHNSON, JAMES C.             105    444-5555
JONES, KEITH                  111    222-1122
METZ, GLADYS G.               112    662-4578
PASTERNACK, LAWRENCE          105    NONE
PETERSON, GERALD              116    555-3456
SMITH, ROGER                  103    234-5678
VALDEZ, JUAN                  103    335-6789
WYNN, EDWARD G.               124    666-9944
```

Listing 5. Emergency phone number list.

```
FILE FACTORY      PAYROLL      FILE CODE 1
FILE CREATED 07/05/79      FILE UPDATED 07/29/79      14 ENTRIES

NAME                          EMER PH        DEPT

GEORGE ABBOTT                 132-1321       123
GEORGE BROWN                  343-3232       245
MARYANN E. BROWN              123-9876       300
KAREN J. BROWNE               333-3333       123
DANIEL J. HUDSON              355-6879       123
JAMES C. JOHNSON              444-5555       105
KEITH JONES                   222-1122       111
GLADYS G. METZ                662-4578       112
LAWRENCE PASTERNACK           NONE           105
GERALD PETERSON               555-3456       116
ROGER SMITH                   234-5678       103
JUAN VALDEZ                   335-6789       103
EDWARD G. WYNN                666-9944       124
```

Listing 6. Sequence of fields has been changed from Listing 5.

columns exceeds the page length margin, the line is broken at the beginning of the next field and a new line is started with an offset of five characters. The offset is provided to allow the reader to align the column with the title when the report is read. This report was set for double spacing, which occurs after the line has been completed. Note also that the data is aligned with the first character of the title. This approach, rather than centering the title, seems to make it easier to read.

Note that the total for the hourly pay (HR/PAY) field is printed at the bottom of the report.

Column width is determined by a subroutine that determines the largest field size, title length or dollars as formatted. To this, two spaces that determine the spacing are added.

Listing 2 is an address list sorted alphabetically by name; the first and last names have been reversed by the program.

Listing 3 is a seniority list sorted by hire date.

Listing 4 shows a sort by department, LG (labor grade) and hourly pay. Note that the hire date and emergency phone are also printed. The hourly pay field is totaled.

Listing 5 is an emergency phone number list for all employees. The same alphabetical sort by name, as used in Listing 2, is used here.

Listing 6 is the same as Listing 5, except the sequence of the fields is changed.

The sample runs shown here are indicative of the type of report preferred by the business user, with the flexibility required by the home computer owner. However, the report you request is really limited only to what you desire, providing it is within the capabilities of the system.

The Recovery Program

The axiom regarding necessity and invention applies fully to my development of the RECOVERY program. One stormy day, while I was entering data into my music catalog file, we experienced a power failure in the area. Although the power failure was momentary, it was of long enough duration to drop the data in RAM. I had started the day with about 100 entries in the file and had added about 600 more.

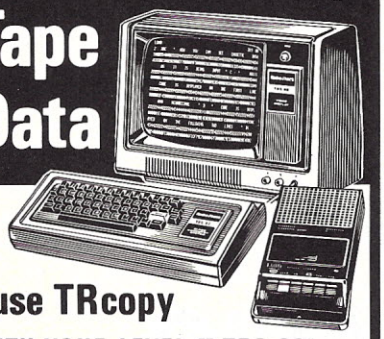
The MAINT program adds the data to the file as each entry is complete, but the end of file marker used by the disk system was never reset. In other words, only 100 records of the file could be accessed by the computer.

The RECOVERY program permits the operator to move (or step) the end of file marker to the first incorrect (garbage or empty) record and reset the marker. When reading the data displayed by this program, keep in mind that the data isn't broken down into fields. However, it is clear enough for the operator to recognize good data and make the end of file determination.

It is a good idea to make a backup copy of the file before working with it. It is always possible to wipe out your data base due to a hardware or software fluke in the system.

This completes the description of the features and operation of the data base management system. Next month, in part 2, we will begin examining the actual BASIC programs that comprise the system. ■

See and Copy Tape Data



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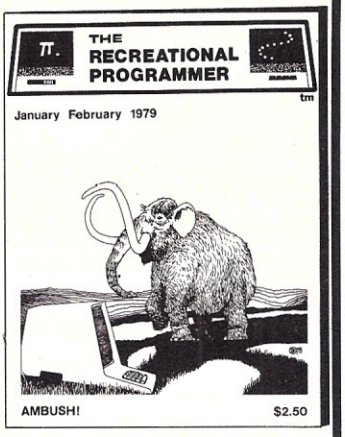

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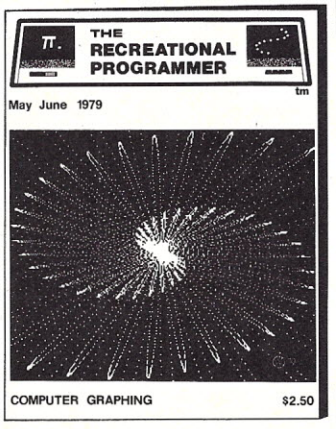

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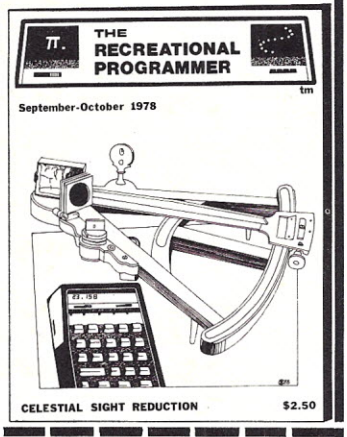

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A Relocator for North Star BASIC

See how many uses for this application you can locate in this article.

Having had about a year's experience working with the North Star minidisk system, I think I can safely say that it is a convenient little unit. Both the hardware and software (DOS and BASIC) provided seem to be reasonably well thought out and work together satisfactorily. Even though I've since acquired a second drive and some more sophisticated software, I still find myself reaching for the North Star BASIC/DOS combination when I want to write a quick and dirty program, because I can start writing in just about nothing flat.

The system has a certain simplicity that I find attractive, even though the file-managing capabilities aren't quite as convenient as, say, the version of CP/M for minifloppy systems. Still, I think most owners will agree that they now have their hands on quite a nice, cost-effective system, especially when they stop to consider that most of us who bought such a system were able to retire older, less convenient cassette or paper tape systems.

Lest I be accused of writing an ad for North Star, I think it's only fair to say that I think they did miss the point on a couple of matters when they designed their software. One of my nagging questions has always been: "Why on earth did they start the standard DOS at 2000H instead of something more logical (0000H)?"

I'm sure I'm not alone in saying that it can cause some inconvenience, especially if you're running a different system part of the time and want your memory to start at 0000H, whereas with North Star BASIC you gain the most space for programs if your memory is addressed starting at 2000H.

Although I've lived quite nicely with this for a year or so, the idea struck me recently that it might be nice to be able to relocate the system to take better advantage of the available memory and not have to be constantly readdressing memory boards. Of course, you can purchase a custom version of either DOS or BASIC from North Star for your own special configuration, but this requires a minor capital outlay. Besides, with a relocator of your own you could create as many different versions as you had a use for at no expense or inconvenience . . . and perhaps have some fun doing it.

Relocator program.

```
10 REM RELOCATOR FOR NORTH STAR BASIC, REL. 4
20 REM WRITTEN BY LANCE E. ROSE, 4/79
30 REM
40 REM FIND OUT IF 8 OR 14 DIGIT VERSION
50 PRINT
60 INPUT "8-DIGIT OR 14-DIGIT? ",Q$
70 IF Q$="" THEN B=8
80 IF Q$="8" THEN B=8
90 IF Q$="14" THEN B=14
100 IF B=0 THEN 60
110 REM GET DRIVE NUMBER TO GET STANDARD BASIC FROM
120 PRINT
130 INPUT "DRIVE NUMBER FOR STANDARD BASIC: ",Q$
140 IF Q$="" THEN D1=1
150 IF Q$="1" THEN D1=1
160 IF Q$="2" THEN D1=2
170 IF Q$="3" THEN D1=3
180 IF D1=0 THEN 130
190 REM GET DRIVE NUMBER TO PUT NEW BASIC ON
200 PRINT
210 INPUT "DRIVE NUMBER FOR RELOCATED BASIC: ",Q$
220 IF Q$="" THEN D2=1
230 IF Q$="1" THEN D2=1
240 IF Q$="2" THEN D2=2
250 IF Q$="3" THEN D2=3
260 IF D2=0 THEN 210
270 REM GET STARTING ADDRESS FOR NEW BASIC
280 PRINT
290 INPUT "STARTING ADDRESS FOR RELOCATED BASIC(HEX): ",Q$
300 IF Q$="" THEN N1=10752 ELSE GOSUB 3700
310 IF N1>51712 THEN 290
320 N=N1
330 O=N-10752
340 REM GET ADDRESS FOR DOS USED FOR BASIC'S I/O
350 PRINT
360 INPUT "STARTING ADDRESS FOR DOS TO BE USED(HEX): ",Q$
370 IF Q$="" THEN N1=8192 ELSE GOSUB 3700
380 IF N1>60416 THEN 360
390 REM OPEN THE STANDARD BASIC FILE
400 IF B=8 THEN T$="BASIC," ELSE T$="BASIC14,"
410 T$=T$+CHR$(48+D1)
420 OPEN #0%1,T$,L
430 REM GENERATE NAME BASED ON LOCATION OF NEW BASIC
440 T1=N
450 T$="    "
460 FOR I=1 TO 4
470 T=INT(T1/16^(4-I))
480 T1=T1-16^(4-I)*T
490 IF T<10 THEN T$(I,I)=CHR$(48+T) ELSE T$(I,I)=CHR$(55+T)
500 NEXT I
510 IF B=8 THEN T$="B08-"+T$ ELSE T$="B14-"+T$
520 T$=T$+","+CHR$(48+D2)
530 REM IF NEW BASIC FILE EXISTS, DESTROY AND MAKE NEW ONE
540 IF FILE(T$)<>-1 THEN DESTROY T$
550 CREATE T$,L,0
560 OPEN #1%0,T$
570 REM INITIALIZE MEMORY POINTER
580 M=10752
590 REM RELOCATION SECTION - CALLS APPROPRIATE SUBROUTINES
600 REM FOR DIFFERENT SECTIONS
```

Relocation

To digress for a moment into the principles involved in moving a language such as BASIC from one part of memory to another: The primary obstacle when dealing with any software written for the 8080 is the lack of any indexed or relative addressing scheme. This means that a program must reside in a particular part of memory to run correctly. If it is moved without changes to somewhere else and then executed, all bets are off. And if you have a memory-mapped video as I do, you'll probably see all sorts of funny patterns sudden-

ly appear on the screen, signifying a software explosion.

The way around this, of course, is to change all the instructions that reference a memory location so that they reference a new location offset by a fixed amount from the original one. If you have a source program and an assembler, this can be done by simply changing the ORG statement at the beginning.

Unfortunately, with very few exceptions, nobody these days is interested in providing source listings for anything as complex as a BASIC or other high-level language. The reasons for this have been argued back and forth for years without resolution, but that's what we're stuck with for now.

So, if no source listing is available, what do you do? The answer is you create one. This is easier said than done for a language as long as BASIC where the source can easily run 4000–5000 lines. Still, we have to begin somewhere; since I have a home-brew disassembler that provides cross-referenced listings, that's just what I did.

Even though the above step seems to be a tough one, the most difficult part still remains: the examination and identification of each part of the program to see whether it consists of instructions or data. If the program consists of instructions, you must identify those instructions that reference memory locations that must be changed and those that ought to be left alone.

With program data there is a similar problem in that many tables contain a sequence of 2-byte addresses referencing the different locations where your favorite commands and functions live (READ, GOTO, SIN, etc.), whereas other data areas are only ASCII strings of error messages or floating point representations such as pi. The latter should be left alone, whereas the former need to have an offset applied to them so that they will run properly.

With this last bit of information, you can generate a new BASIC by simply applying the proper offset to the parts of the program that need it. One way to do this is to somehow write the source listing to a disk file and then reassemble it.

However, knowing which areas need special treatment, you can bypass the assembly process and simply add the required offset where necessary. This can be done in machine language and would probably run the fastest that way, but it can also be done in BASIC using the file-accessing commands available to take a copy of standard BASIC located on a disk, process it a little at a time in memory and write the relocated BASIC to a new disk file. When you are finished, this new file can be run as BASIC at a new location in memory and use either the standard DOS or another DOS that can also be relocated using a similar procedure.

The Program

The program to relocate BASIC is really quite simple. It is also quite long because each time a break occurs in the type of code being relocated, a new value must be assigned to M1, and a call to a subroutine must be made. Loading and executing the program is direct and to the point. When the program is run, you will see that it asks for some information with prompts. Each time a prompt is printed you can type a carriage return, and the program will default to certain values. For the number of digits, the default is 8; for the disk drives, it is drive #1; for the starting address of BASIC, it is 2A00H; and for the DOS, it is 2000H.

I've tried to make it impossible (or at least difficult) to enter parameters that wouldn't make sense, but it pays to show a little caution anyway. Once the program begins running, you might as well go get yourself a cup of coffee—or an entire meal if desired. It takes about 30 minutes to churn through the file.

Certain prerequisites are necessary before running. The standard BASIC must be in a Type 1 file called "BASIC" for the 8-digit version, or "BASIC14" for the extended precision version. Also, the BASIC must be Release 4 for the program to work.

```
610 M1=10766
620 GOSUB 3930
630 M1=10769
640 GOSUB 4290
650 GOSUB 4350
660 GOSUB 4290
670 GOSUB 3930
680 M1=10777
690 GOSUB 4290
700 M1=10988
710 GOSUB 3880
720 M1=11256
730 GOSUB 3880
740 M1=11421
750 GOSUB 3930
760 M1=11707
770 GOSUB 4290
780 M1=12040
790 GOSUB 3880
800 M1=12118
810 GOSUB 3880
820 M1=12153
830 GOSUB 3800
840 M1=12199
850 GOSUB 3800
860 M1=12216
870 GOSUB 3800
880 M1=12278
890 GOSUB 3880
900 M1=12291
910 GOSUB 3800
920 M1=12311
930 GOSUB 3880
940 M1=12319
950 GOSUB 3800
960 M1=12324
970 GOSUB 3800
980 M1=12329
990 GOSUB 3800
1000 M1=12350
1010 GOSUB 3800
1020 M1=12390
1030 GOSUB 3800
1040 M1=12402
1050 GOSUB 3800
1060 M1=12437
1070 GOSUB 3800
1080 M1=12481
1090 GOSUB 3800
1100 M1=12496
1110 GOSUB 3800
1120 GOSUB 3900
1130 M1=12519
1140 GOSUB 3880
1150 M1=12565
1160 GOSUB 3880
1170 M1=12671
1180 GOSUB 3800
1190 M1=12814
1200 GOSUB 3880
1210 M1=13065
1220 GOSUB 3880
1230 M1=13098
1240 GOSUB 3880
1250 M1=13134
1260 GOSUB 3880
1270 M1=13278
1280 GOSUB 3880
1290 M1=13319
1300 GOSUB 3880
1310 M1=13387
1320 GOSUB 3880
1330 M1=13406
1340 GOSUB 3880
1350 M1=13434
1360 GOSUB 3880
1370 M1=13676
1380 GOSUB 3880
1390 M1=13747
1400 GOSUB 3880
1410 M1=13807
1420 GOSUB 3880
1430 M1=14027
1440 GOSUB 3880
1450 M1=14040
1460 GOSUB 3880
1470 M1=14103
1480 GOSUB 3880
1490 M1=14158
1500 GOSUB 3880
1510 M1=14656
1520 GOSUB 3930
1530 M1=14677
1540 GOSUB 4290
1550 M1=14825
1560 GOSUB 3930
1570 O=-O
1580 GOSUB 3930
1590 O=-O
1600 M1=15056
1610 GOSUB 3930
1620 IF B=14 THEN M=M-3
1630 M1=15109
1640 GOSUB 4290
1650 M1=15131
1660 GOSUB 4350
1670 O1=O
1680 O=N1-8192
1690 GOSUB 4350
1700 O=O1
1710 M1=15205
1720 GOSUB 4350
1730 M1=15620
1740 GOSUB 4290
1750 FOR I=1 TO 8
1760 GOSUB 4290
1770 GOSUB 4350
1780 NEXT I
1790 M1=15648
1800 GOSUB 4290
1810 GOSUB 4350
1820 FOR I=1 TO 22
1830 GOSUB 4290
1840 GOSUB 4350
1850 NEXT I
1860 M1=15792
1870 GOSUB 3880
1880 M1=16061
1890 GOSUB 3880
1900 M1=16116
1910 GOSUB 3800
1920 M1=16131
1930 GOSUB 3880
1940 M1=16155
1950 GOSUB 3880
1960 M1=16178
1970 GOSUB 3930
1980 IF B=14 THEN M=M-12
1990 M1=16198
2000 GOSUB 4290
2010 M1=16300
2020 GOSUB 3930
2030 IF B=14 THEN M=M-6
2040 M1=16310
2050 GOSUB 4290
2060 M1=16446
2070 GOSUB 3880
2080 M1=16507
2090 GOSUB 3880
2100 M1=16514
2110 GOSUB 3930
2120 IF B=14 THEN M=M-3
2130 M1=16519
2140 GOSUB 4290
2150 M1=16538
2160 GOSUB 3880
2170 M1=16561
2180 GOSUB 3880
2190 M1=16672
2200 GOSUB 3880
2210 M1=16683
2220 GOSUB 3880
2230 M1=16696
2240 GOSUB 3800
2250 M1=16763
2260 GOSUB 3880
2270 M1=16795
2280 GOSUB 3880
2290 M1=16819
2300 GOSUB 3880
2310 M1=16828
2320 GOSUB 3880
2330 M1=16836
2340 GOSUB 3880
2350 M1=16882
2360 GOSUB 3880
2370 M1=16903
2380 GOSUB 3880
2390 M1=16959
2400 GOSUB 3880
2410 M1=16968
2420 GOSUB 3880
2430 M1=17253
2440 GOSUB 3880
2450 M1=17307
2460 GOSUB 3880
2470 M1=17381
2480 GOSUB 3880
2490 M1=17395
2500 GOSUB 3880
2510 M1=17419
2520 GOSUB 3880
2530 M1=17694
2540 GOSUB 3880
2550 M1=17744
2560 GOSUB 3880
2570 M1=17831
2580 GOSUB 3880
2590 M1=17855
2600 GOSUB 3880
2610 M1=17920
2620 GOSUB 3880
2630 M1=17933
2640 GOSUB 3880
2650 M1=18101
2660 GOSUB 3880
2670 M1=18105
2680 GOSUB 3880
2690 M1=18219
2700 GOSUB 3880
2710 M1=18237
2720 GOSUB 3930
2730 IF B=14 THEN M=M-3
2740 M1=18242
2750 GOSUB 4290
2760 M1=18327
```

```
2770 GOSUB 3880
2780 M1=18356
2790 GOSUB 3880
2800 M1=18422
2810 GOSUB 3880
2820 M1=18428
2830 GOSUB 3880
2840 M1=18434
2850 GOSUB 3880
2860 M1=18440
2870 GOSUB 3880
2880 M1=18446
2890 GOSUB 3880
2900 M1=18485
2910 GOSUB 3800
2920 M1=18838
2930 GOSUB 3800
2940 M1=18889
2950 GOSUB 3800
2960 M1=19157
2970 GOSUB 3880
2980 M1=19202
2990 GOSUB 3880
3000 M1=19528
3010 GOSUB 3880
3020 M1=19680
3030 GOSUB 3880
3040 M1=20183
3050 GOSUB 3880
3060 M1=20928
3070 GOSUB 3880
3080 M1=20972
3090 GOSUB 3880
3100 M1=21052
3110 GOSUB 3880
3120 M1=21115
3130 GOSUB 3880
3140 M1=21273
3150 GOSUB 3880
3160 M1=21311
3170 GOSUB 3800
3180 M1=21344
3190 GOSUB 3880
3200 M1=21412
3210 GOSUB 3880
3220 M1=21440
3230 GOSUB 3880
3240 M1=21472
3250 GOSUB 3880
3260 M1=21519
3270 GOSUB 3800
3280 M1=21560
3290 GOSUB 3880
3300 M1=21581
3310 GOSUB 3880
3320 M1=21604
3330 GOSUB 3880
3340 M1=21642
3350 GOSUB 3880
3360 M1=21657
3370 GOSUB 3880
3380 M1=21674
3390 GOSUB 3800
3400 M1=21680
3410 GOSUB 3800
3420 M1=21684
3430 GOSUB 3930
3440 IF B=14 THEN M=M-27
3450 M1=22450
3460 GOSUB 4290
3470 M1=22733
3480 GOSUB 3930
3490 IF B=14 THEN M=M-38
3500 M1=22783
3510 GOSUB 4290
3520 M1=22968
3530 GOSUB 3930
3540 IF B=14 THEN M=M-46
3550 M1=23018
3560 GOSUB 4290
3570 M1=23229
3580 GOSUB 3930
3590 IF B=14 THEN M=M-48
3600 M1=23269
3610 GOSUB 4290
3620 M1=23387
3630 GOSUB 3930
3640 IF B=14 THEN M=M-70
3650 M1=23552
3660 GOSUB 4290
3670 PRINT
3680 END
3690 REM SUBROUTINE TO CONVERT FROM HEX STRING TO DECIMAL
3700 N1=0
3710 FOR I=1 TO LEN(Q$)
3720 Q=ASC(Q$(I,I))-48
3730 IF Q>=0 AND Q<=9 THEN 3760
3740 Q=Q-7
3750 IF Q<10 OR Q>15 THEN N1=10000
3760 N1=16*N1+Q
3770 NEXT I
3780 RETURN
3790 REM SUBROUTINE TO HANDLE DOS REFERENCES
3800 GOSUB 3930
3810 O1=O
3820 O=N1-8192
3830 GOSUB 3930
3840 O=O1
3850 RETURN
3860 REM SUBROUTINE TO RELOCATE INSTRUCTIONS FOLLOWED BY A
3870 REM 3-BYTE FIXED INSTRUCTION
3880 GOSUB 3930
3890 REM SUBROUTINE TO HANDLE 3-BYTE FIXED INSTRUCTIONS
3900 Q$="H"
3910 GOTO 3940
3920 REM SUBROUTINE FOR NORMAL INSTRUCTIONS
3930 Q$="L"
3940 READ #0,&X
3950 WRITE #1,&X,NOENDMARK
3960 M=M+1
3970 REM FIND 3-BYTE INSTRUCTIONS
3980 IF X=195 OR X=205 THEN 4200
3990 IF X=1 OR X=17 OR X=33 OR X=49 THEN 4200
4000 IF X=34 OR X=42 OR X=50 OR X=58 THEN 4200
4010 IF X=194 OR X=196 OR X=202 OR X=204 THEN 4200
4020 IF X=210 OR X=212 OR X=218 OR X=220 THEN 4200
4030 IF X=226 OR X=228 OR X=234 OR X=236 THEN 4200
4040 IF X=242 OR X=244 OR X=250 OR X=252 THEN 4200
4050 REM FIND 2-BYTE INSTRUCTIONS
4060 IF X=211 OR X=219 THEN 4150
4070 IF X=6 OR X=14 OR X=22 OR X=30 THEN 4150
4080 IF X=38 OR X=46 OR X=54 OR X=62 THEN 4150
4090 IF X=198 OR X=206 OR X=214 OR X=222 THEN 4150
4100 IF X=230 OR X=238 OR X=246 OR X=254 THEN 4150
4110 REM ALL INSTRUCTIONS LEFT ARE 1 BYTE
4120 IF M<M1 THEN 3930
4130 RETURN
4140 REM 2-BYTE INSTRUCTIONS
4150 READ #0,&X
4160 WRITE #1,&X,NOENDMARK
4170 M=M+1
4180 GOTO 4120
4190 REM 3-BYTE INSTRUCTIONS
4200 READ #0,&Y,&X
4210 IF Q$="H" THEN 4250
4220 Y=256*X+Y+O
4230 X=INT(Y/256)
4240 Y=Y-256*X
4250 WRITE #1,&Y,&X,NOENDMARK
4260 M=M+2
4270 GOTO 4120
4280 REM SUBROUTINE TO HANDLE BYTE DATA
4290 READ #0,&X
4300 WRITE #1,&X,NOENDMARK
4310 M=M+1
4320 IF M<M1 THEN 4290
4330 RETURN
4340 REM SUBROUTINE TO HANDLE WORD DATA
4350 READ #0,&Y,&X
4360 Y=256*X+Y+O
4370 X=INT(Y/256)
4380 Y=Y-256*X
4390 WRITE #1,&Y,&X,NOENDMARK
4400 M=M+2
4410 IF M<M1 THEN 4350
4420 RETURN
```

The result of the program is a file of the same length as the standard version, and with a name that includes the starting address in it. The naming format is Bpp-xxxx, where pp is the number of digits of precision (8 or 14) and xxxx is the hexadecimal starting address.

After completion, you must assign the file a type of 1 and give it a go-address (which will, of course, be the same address as that included in the name) from DOS; there just isn't any convenient way to assign a go-address from BASIC. Once this is done you're ready to test it by typing GO B08-3400 (for example). BASIC should load and give its READY prompt. You can then use MEMSET, if desired, to allow more space for your programs commensurate with how much memory you have available. Any programs written in standard BASIC should be compatible with relocated versions of same.

Many people don't realize that programs written in the 8-digit version can be run in the 14-digit version and vice versa, but with a loss of precision. This does not hold true of data files, however, so don't try it for those.

Uses

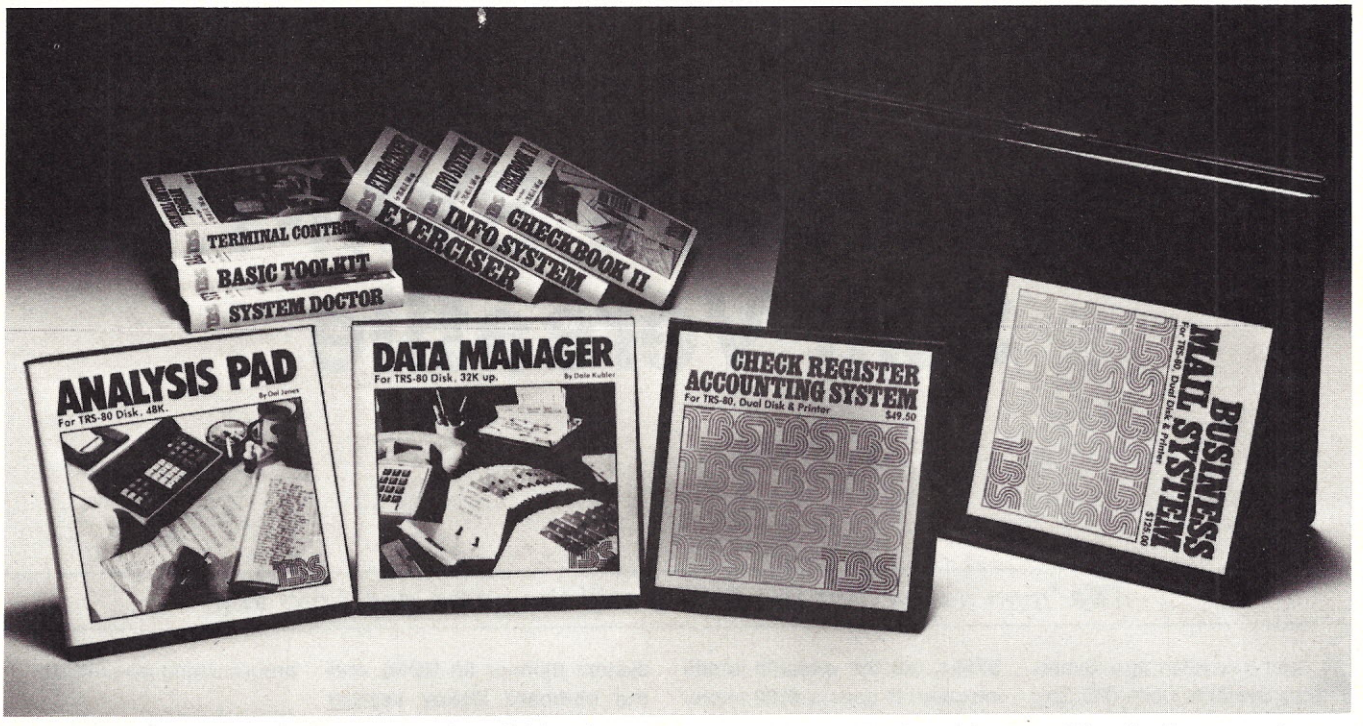
I can think of several uses offhand. One is to create a version of BASIC that can be run at 3400H. The rationale behind this is that if while you're programming, you suddenly run out of disk space but have room on the lower disk tracks, you have to run COMPACT to open up some space on the disk. Unfortunately, when this happens it uses a scratch area of ten blocks immediately following the DOS to move files around. So, unless you have yet another disk with space on it to save your BASIC program while COMPACT writes all over the first part of BASIC, you're out of luck.

By putting BASIC at 3400H you can run COMPACT (or use the IN or DT commands in DOS) without disturbing BASIC or its program. Then you can reenter BASIC from DOS and save the program you've been working so hard on before it evaporates. Of course, you have to give up about 2.5K of memory in BASIC to do this, but these days memory seems to be becoming more plentiful and less expensive, and it need not be all that much of a problem.

Another application is to relocate both the DOS and BASIC to run at the beginning of memory, say with the DOS at 0000H and BASIC immediately thereafter (either with or without the ten-block scratch area in between). There are commercial programs available for moving the DOS, so I won't discuss it here—except to say you might want to try it yourself to keep you out of trouble on those rainy or snowy afternoons. With a setup like this, there's no more fiddling with DIP switches to change those memory board addresses when going from CP/M to North Star and back.

If you're really handy at patching, you can write some short routines to use the CP/M I/O drivers with North Star BASIC. The file-accessing patches are much harder, but possible. With just the I/O though, you can call BASIC as a CP/M COM file and at least write and run programs even if you can't save them. A version of BASIC relocated to 0100H is the heart of this particular application. ■

THE VERY BEST.



If you're serious about your TRS-80 computer, try these disk based programs. When it comes to hardcore software, noboby does it like **TBS.**

BUSINESS MAIL SYSTEM by Dale Kuber is designed for large-scale business users. Requiring 32K, two disks and printer, this program will store up to 150,000 names in a single file spread out over multiple disks. Each data disk holds 500 names. After data entry, **BMS** automatically sorts the data by zip code and alphabetical order within the zip code. The program tells you when and which data disk to insert, expanding your files automatically until you've reached 300 disks. Data is input directly onto formatted screen display with the option to use Company Name/Attention instead of Last Name/First Name. Three numeric and one alpha code fields are provided to help you use the search and printout mode. **BUSINESS MAIL SYSTEM** allows you to program the number and spacing of your labels and then print out and read your data disks concurrently using accelerated printing. (This mode works only with Centronics printers.) With more features than can be described here, this high-powered program sells for $125.00.

ANALYSIS PAD by Del Jones is the epitome of first-class programming in business applications. Requiring 48K, and one disk with a printer recommended, this columnar calculator gives the user tremendous flexibility in data entry enabling the user to create 30 or more columns and rows. Enter your own column and row labels. Enter your data by row or column or directly onto screen display via edit mode. Move, swap, delete, and add rows or columns. Create new pads by stripping relevant data from old files. You never have to key in data twice. But more important than the powerful data manipulation provided, you can add, subtract, multiply and divide one column by another and put results in another column. You can perform up to six calculations on one column and even define one column to be a constant. The calculation routine you create can be saved and reused. Print out the entire pad in four column segments to line or serial printer. **ANALYSIS PAD** was originally advertised for 32K tape at $32.50. Since then it has been totally rewritten and expanded to its present 48K disk only form and sells for $49.50. It is easily worth twice as much. You have to see it to believe it.

DATA MANAGER by Dale Kubler starts out where INFORMATION SYSTEM leaves off. Requiring 32K and one disk, it accepts up to ten user-defined fields with up to forty characters per field and 255 characters per record. As with all TBS software, data entry and editing is professional and simple to use. What makes this program stand apart from "in-mem" data managers is that it uses up to four disks on line as memory, or as much as 320K of memory storage. Because disk sorts take more time than in-mem sorts, **DATA MANAGER** enables the user to create and maintain up to 5 "key" sort files for quick access of data. A utility program is provided to calculate the number of records possible since the amount of records you can maintain is dependent on a number of variables. This program also supports the upper/lower case modification, and printouts can be programmed to almost any format and sent to line or serial printer. For Centronic printers, accelerated printing is provided enabling the computer to search and print at the same time. If you already have INFORMATION SYSTEM, **DATA MANGER** will accept those files. (We are currently working on a program that will merge your data files with Electric Pencil files.) A necessity for organized people, this program sells for $49.50.

CHECK REGISTER ACCOUNTING SYSTEM, adapted for the TRS-80 by Dale Kubler and originally written by O.E. Dial, is the most comprehensive check-balancing program written. Requiring 32K, two disks and printer, this program does much more than just balance and reconcile your checkbook. It enables you to define up to 60 account names and will generate monthly summaries of all accounts with monthly and year-to-date totals. Single-entry input allows the user to disperse one transaction over several accounts and to make a 64-character note on each transaction. Checks can be printed out after data has been entered. Aside from the Statement of Accounts, **CRAS** also generates the following reports: Check Register for any Month, Notes to Check Register, Income/Expense Distribution, Statement of Selected Accounts, Bank Reconcile Statement and Suspense File. The Suspense file is an extra feature where you can make notes to yourself for any month in the year. **CRAS** will make both you and your accountant happy and it sells for $49.50.

TBS has other great software for your TRS-80. **BASIC TOOLKIT, SYSTEM DOCTOR & TERMINAL CONTROL** are system utilities. **CHECKBOOK II, INFORMATION SYSTEM & EXERCISER** are general applications. Don't forget the **LIBRARY 100;** 100 programs for only $49.50. **TBS** also has **DISK HEAD CLEANERS** for **TRS-80** and **APPLE** and **GRAN MASTER DISKETTES,** the best on the market.

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Synertek's SYM-1: Still Versatile

The 'nym's new, but the SYM's still the same good old VIM.

About 1½ years ago, Synertek Systems Corp. (PO Box 552, Santa Clara CA 95052) introduced their Versatile Interface Module (VIM). It's now called the SYM-1, but the versatile is still included. It uses a 6502 microprocessor that makes the SYM-1 a cousin of the KIM-1. The SYM-1 includes an excellent 4K system monitor (in ROM), and the on-board 28-key keypad (along with a 6-digit hex format display) will get you started right away into machine-language programming (see Fig. 1).

SYM-1 Features

Before going into more detail on the features of the system

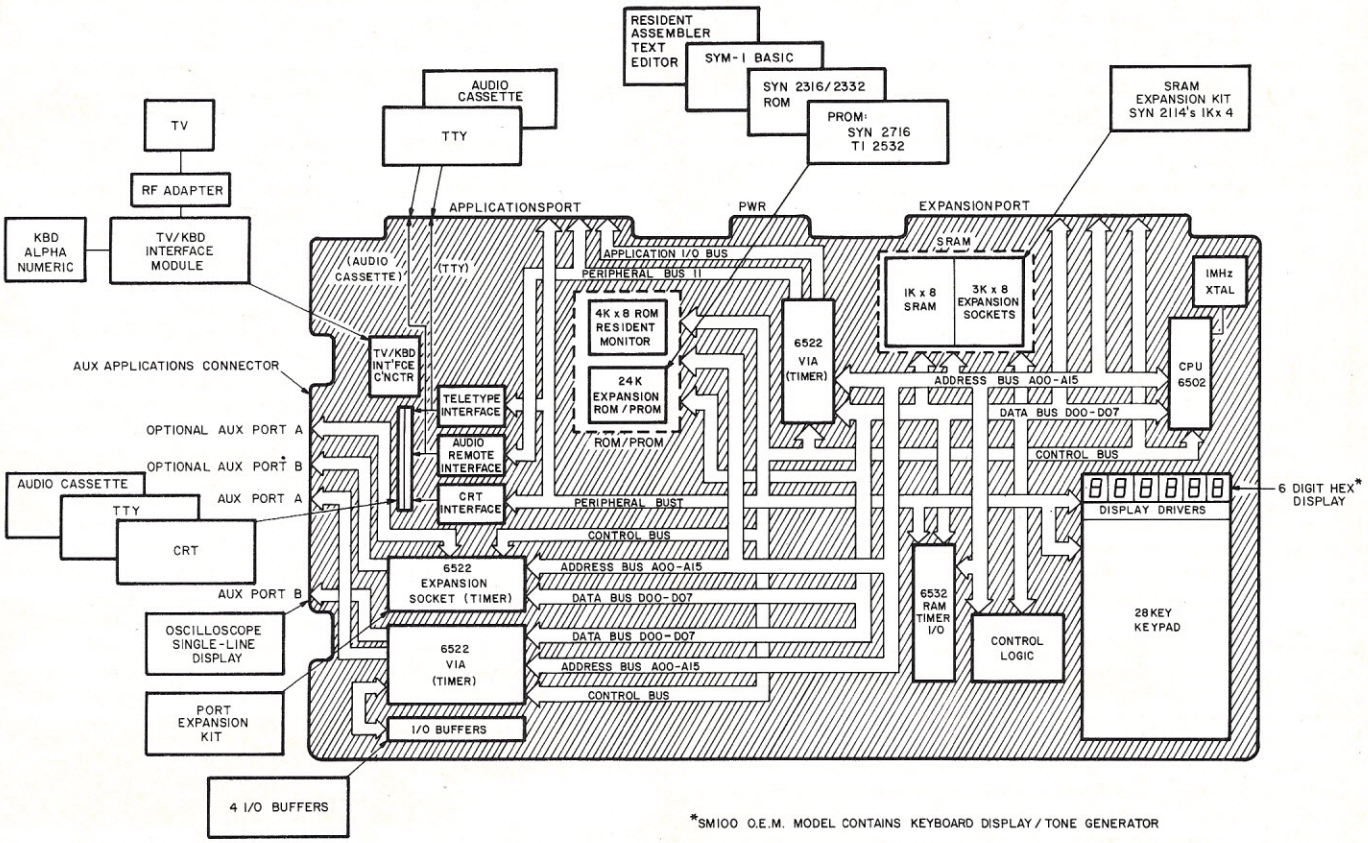

Fig. 1. Block diagram of the SYM-1 board (reprinted courtesy of Synertek Systems Corp.).

monitor, let me skim over some of the SYM-1's features. The board comes with 1K of 2114-type RAM and is expandable (on-board) to a healthy 4K worth of RAM. In addition to this, decoding is provided to add another 4K of RAM (off-board).

As mentioned before, the system monitor resides in ROM, but three sockets are provided to add up to 24K bytes of additional ROM/PROM. Addressing jumpers are provided so that each socket can accommodate any of four different types of read only memory devices.

On-board interfaces include a cassette interface complete with remote control (on/off of cassette recorder motor) that is usable in two modes: KIM-1 compatible and high speed (nearly 1500 baud). A Model 33 Teletype can be added through the 20 mA teleprinter interface, or if you'd rather use an RS-232 CRT terminal, an interface is provided for this also.

All of the software needed to support the cassette, Teletype and CRT terminal interfaces is included in the system monitor. In addition to this, the SYM-1 automatically adjusts for baud rates from 300–4800 baud (inclusive) when the CRT terminal interface is used. For users without terminals, the SYM-1 provides an oscilloscope driver that will allow you to use an ordinary oscilloscope to display one line of 32 characters; the software for this scope driver is included in the SYM-1 reference manual.

For input/output and timing applications, the board comes with two 6522 VIAs (versatile interface adapter) and one 6532 device. These three devices are worthy of a chapter by themselves; they are one of the big reasons the SYM-1 is so versatile. The 6532 has an on-chip programmable interval timer; its I/O ports are used to interface the keypad/display or any other user-supplied terminal to the microprocessor.

The 6522 devices include two on-chip timers—an interval timer (that can double as a "pulse counter") and a timer that can operate either in a free-running mode or in the "interval" mode. The 6522s also include two 8-bit bidirectional I/O ports (with "handshake" capability) that can be configured in any I/O combination through the 6522's Data Direction registers. In fact, some of the features of the SYM-1 (such as the scope driver, cassette interface and the write protection of user RAM) use part of these VIAs.

If this I/O capability is not enough for you, a socket is provided so you can add one more 6522 to the SYM-1 to give you 16 additional I/O lines (with handshaking lines), plus the timers and other on-chip functions. Four buffers are also provided on-board (on four I/O pins of VIA #3) that the user can configure in any way he chooses.

And there's one nice thing about the SYM-1 that I've saved for now: It's already assembled and fully tested; all you add is a single +5 V supply.

System Monitor

I left the discussion of the system monitor for now because if you bought a microcomputer to learn about it and its microprocessor (as I did), then you'll want an operating system that's versatile and thorough enough to allow you debugging facilities and to give you the ability to examine registers, move data around and so on. It would take too much space to describe each of the system commands, so here is just a list: Memory Examine/Modify, Memory Search, Register Examine/Modify, Go (to start the program at immediate address or address given), Verify (display eight bytes in memory or any number of bytes), Deposit To Memory, Calculate (for hexadecimal arithmetic), Move Memory Block (to another location), Jump, Store Double Byte, Fill Memory Locations X-Y With Z, Write Protect (user RAM), Load Tape (KIM-1 or high-speed), Load Paper Tape, Save Paper Tape, Save Tape (KIM-1 or high-speed) and Execute.

In addition to these commands, "+" advances eight bytes (as when in Memory Examine), "–" retreats eight bytes, "→" advances one byte (or register) and "←" retreats one byte. There are eight user-defined keys to enable you to add to the monitor's command repertoire, and there is a system reset key to allow you to sweep your mistakes under the rug. And, of course, there is the DEBUG key/function.

The SYM-1 package.

Pressing DEBUG allows you to single-step through each instruction in your program. Thus, after each instruction is executed, you can examine all of the registers and any memory locations and then go on to the next instruction in your program by pressing GO and Carriage Return (CR).

You can let the monitor step through your program, but at a rate that's closer to jogging rather than mile-a-minute sprinting. By changing the "Trace" velocity, you can set up the monitor to display the Program Counter address and the contents of the accumulator, pause and then resume execution, again one instruction at a time. And there is even a set of error messages to tell you when something is wrong (I still like the Bronx cheer method better).

The error codes are interactive; that is, the error message flashed onto SYM-1's display depends on the context in which the error occurred. This simplifies to a message of "Er XX," where XX is a two-digit representation of the byte that couldn't be digested. Finally, for you programmers, the eight user-defined keys should start you on your way to controlling the world.

Unfortunately, I've had to restrict (and sometimes omit) the descriptions of the SYM-1's features and capabilities. For more detail consult the comprehensive manuals that come with the board.

Applications

With its I/O and timing capabilities, the SYM-1 is an obvious choice for intelligent-controller-type applications. But the board is an application in itself, teaching you machine-language programming and the merits of the 6502 microprocessor, including the versatile combination of its instruction set and addressing capabilities. You can apply what you learn to all microprocessor-based computers, as all microprocessors share common features that will enable even a novice to get his or her foot in the door.

For those interested in programming in a high-level language, there is Synertek's BASIC, which is packaged in two ROMs that plug right into sockets provided on the SYM-1. This extended BASIC even has string functions that should enable you to write a nice text editor or two.

But it is the SYM-1's ability to interface with the real world that will please the utility-minded user most. If he is a photographer, the SYM-1 can automate his darkroom from enlarger timing to agitation of the chem-

icals; if he is interested in an audiovisual display, he can control lighting systems to the tune of his favorite music, creating effects that will make ordinary color-organs pale in comparison.

To an experimenter/hobbyist, the SYM-1 could combine several test instruments into one, such as a frequency counter, digital voltmeter and a programmable pulse generator; for the electronic music enthusiast, the SYM-1 could become the heart of a polyphonic synthesizer, generating envelopes for your VCAs (voltage controlled amplifier) and even making sure you're in tune.

You can write programs that will test ICs (with the addition of some wire and a zero insertion force socket or two), program your EPROMs (and check for errors), move "light" pieces on a game board, secure your home; in short, anything that can be controlled electrically (directly or indirectly) can most probably be controlled and monitored by SYM-1. That includes the coffeepot.

My own uses for SYM-1 have included some of the above (such as the EPROM programmer) plus such things as a geometric art generator that uses an ordinary oscilloscope, and a music program that will play up to 256 notes (any audible frequency) and uses the on-board timers (in the VIAs) for the notes' pitch and duration. When I got the Synertek BASIC, I wrote some "recreational" programs including a conversational program, and even a program that will balance a checkbook.

So, if you like to program in BASIC, or are interested in using a microcomputer as the intelligent heart of any system (from kitchens to multi-channel data-acquisition systems), or if you're just interested in learning about microprocessors and microcomputers, look into the SYM-1.■

Computer Design Labs Z80* Disk Software

We have acquired the rights to all TDL software (& hardware). TDL software has long had the reputation of being the best in the industry. Computer Design Labs will continue to maintain, evolve and add to this superior line of quality software.

— Carl Galletti and Roger Amidon, owners.

All of the software below is available on any of the following media for operation with a Z80 CPU using the CP/M* or similar type disk operating system (such as our own TPM*).

for TRS-80* CP/M (Model One)
for 8" CP/M (soft sectored single density)
for 5¼" CP/M (soft sectored single density)
for 5¼" North Star CP/M (single density)
for 5¼" North Star CP/M (double density)

BASIC I

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Converting Selectric Keyboards from BCD to Correspondence Code

Part 2 of this article plugs into the electrical aspects of converting BCD Selectrics.

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The electrical part of the modification consists of rewiring the contacts in the machine to bring out the additional character selection information made possible by use of the Correspondence code. There are three sets of transmitting contacts. One set of seven pairs is operated by the selector bails to reproduce the six-bit plus parity *character selection* code. A second set consists of five pairs operated by the five machine control, or *operational*, keys. Finally, a set of *shift transmit* contacts senses whether the mechanism is being shifted, and whether to uppercase or lowercase.

To generate codes for a full character set, the shift information must be stored and used as a seventh character selection bit, doubling the number of possible code combinations.

The use of the character selection contacts is completely straightforward. The code from the interposers is reproduced as contact closures and may be directly connected to logic outside the machine. Application of the operational and shift contacts requires some explanation, however.

Operational and Shift Contacts

First, consider the operational contacts. There is a contact pair corresponding to each operational function, which produces an inefficient 1-out-of-5 code. My original intention was to convert this into binary form and to combine the encoded operational information with the character selection code so that both character and control codes would appear on the same output connections, as is the case with ASCII-coded devices. After considerable investigation, I concluded that a simpler, more widely usable modification would result if the machine were simply rewired to IBM's standard for Correspondence-coded Selectric I/O's.

Their approach is to just bring the individual operational contacts out to the connector. This has two advantages. First, it is easy to do. Second, it allows the user to choose either a hardware or a software method of code conversion. A parallel input port could be used to monitor the status of the operational contacts, with a brief lookup table provided to translate contact closures into ASCII control codes. Hardware methods would be more elaborate. An interface with hardware code conversion and handshaking is in the planning stages, and might be the subject of a future article.

The shift transmit contacts, like the operational contacts, would be combined in some manner with the character selection contacts if we intended to put the complete code on a limited number of output lines. As in the case of the operational contacts, I decided instead to do it IBM's way and bring them out individually to the connector.

In BCD machines, because there are fewer codes, IBM found it convenient to take the opposite approach, combining operational codes with character codes. This was done by recoding the operational and shift contact closures into binary form using diodes and connecting them to the character selection contacts.

To complete modification to Correspondence code, this interconnecting wiring and the diodes must be removed. Modifying the wiring is simplified somewhat by IBM's use of taper pins, replaceable connector pins and, on some models, wire-wrap clips for making connections. What follows is a detailed description of the rewiring required.

Rewiring

Fig. 1 is the schematic of a BCD machine. Note the manner in which the character selection and operational contacts are interconnected. Fig. 2 is a complete schematic of Correspondence-coded I/O wiring. Figs. 1 and 2 are all-inclusive; IBM states that there are probably no machines that include all the features shown. My machine did not include a shift magnet or shift mode contacts, though it had shift transmit contacts and a set called C3, which, like shift mode, is a part of the printer handshake for shifting.

In both the Correspondence and BCD versions, the six code bits and the parity bit are brought out to pins r, s, t, u, v, w and x of the 50-pin connector. (If you have one of the few 34-pin units, an unofficial schematic is available from the author. Send a stamped, self-addressed envelope.) The circles marked with a lowercase letter and a number refer to terminals on the taper pin blocks.

Fig. 3a shows the layout of a typical taper pin block; Fig. 3b shows where the blocks are located. Note that the operational and shift mode contacts do

Qty.	Part No.		Price
6	2122258	Male pin (for 50-pin connector)	.80
10	4187243	Taper terminal (also 0187243)	.02
10	1166039	Slip terminal (wire-wrap clip)	.03

Parts list.

Connector Pin	Remove From	Connect To	
r	a3	a2	
s	a2	a4	
t	a6	a6	(no change)
u	a4	a8	
v	b3	b2	
w	b5	b4	
x	b6	b7	

Table 1.

not have their own outside connections in the BCD machine. They are connected to pins z, AA, BB, CC, DD, EE and FF in the Correspondence-coded version. These pins are omitted from the connector in the BCD machine. These connector pins, as well as taper pins and wire-wrap clips, may be purchased from any IBM parts outlet. They are also sold by AMP, Inc., but are difficult to purchase in small quantities from that source.

A list of the parts you will need is included in the article. Tools required are a soldering iron, needle-nose pliers, cutters, wire-strippers, a small and a medium screwdriver and a solder wick or solder-sucker. Take a good look at the underside of your Selectric, and locate the features shown in Fig. 3b. Now you are ready to begin.

Procedure

1. Locate the character selection contact assembly. It is halfway back on the left, under a clear plastic cover.

2. Remove the plastic cover. Replace the two screws. They will serve as guides for dressing wires to clear the cover.

3. Examine the configuration of the contacts. Notice that they are arranged in seven groups, each consisting of four single-pole, double-throw sets. This modification involves only those farthest from the frame. Those closest to the frame are wired to form a parity tree. You will not use it, but it is unnecessary to spend time removing the wiring.

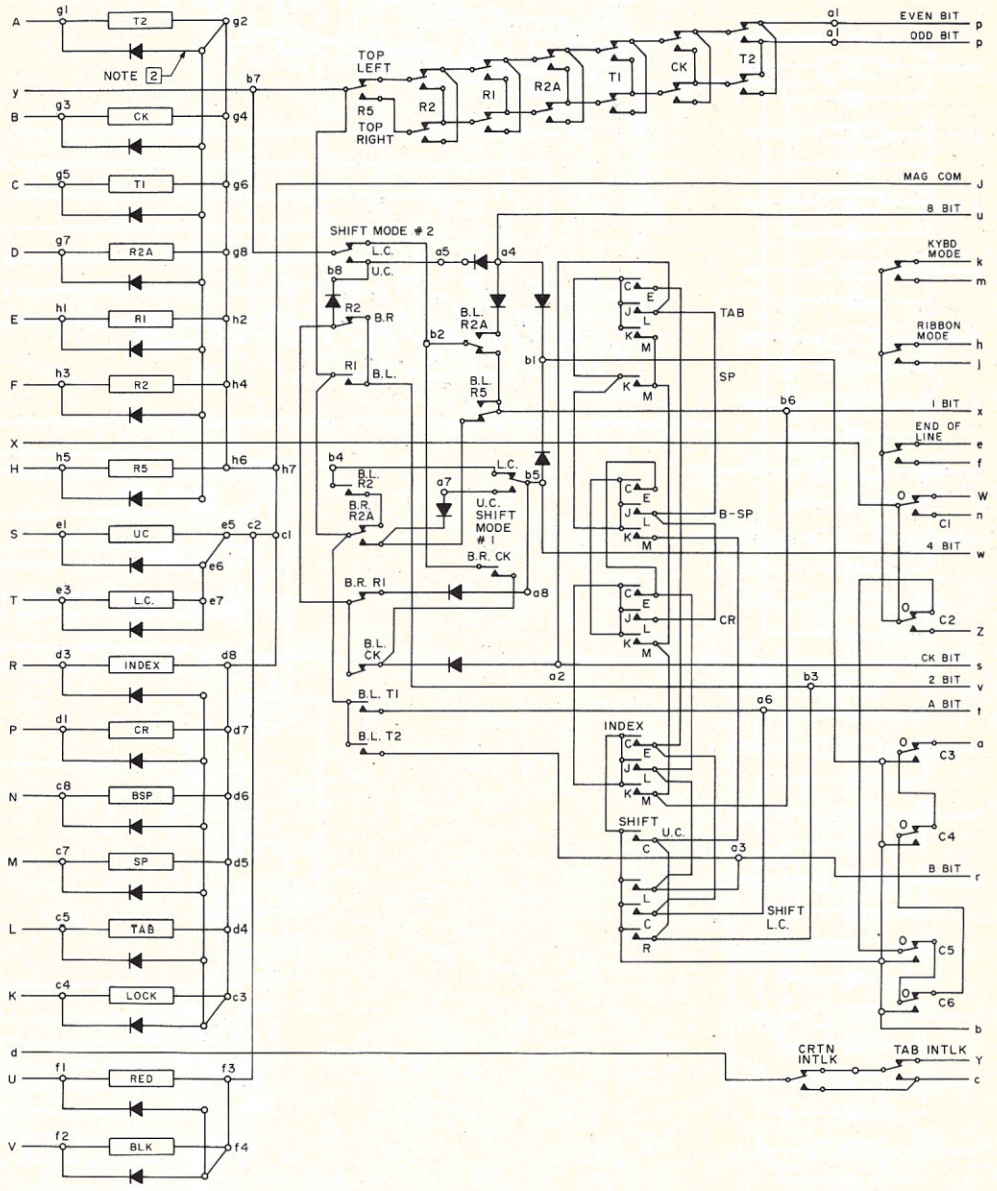
4. Unsolder all the wiring from the lower contacts. Included will be one jumper to the right-hand upper set, which should be unsoldered at both ends.

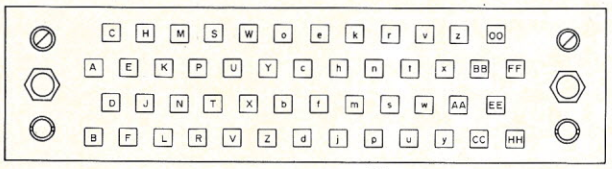
5. Using a needle-nose pliers, disconnect all diodes from the taper pin blocks. Taper pins can be disconnected by a sharp pull straight out from the block.

6. After removal of the diodes, there will be seven taper pins left with hookup wire attached which was previously unsoldered during step 4. Relocate these in the following positions: a2, a4, a6, a8, b2, b4, b7. Move the two pins already in b7 to b8. If there was already a pin in a2, remove it and tie it back.

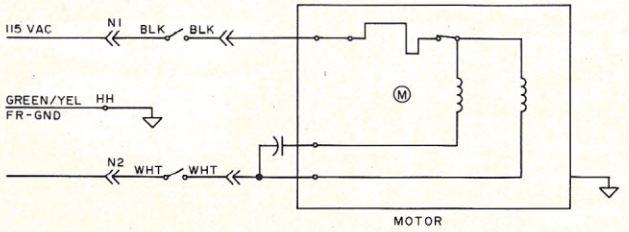
7. Refer to Fig. 4. Install a piece of bus wire, tying together all the center contacts of the lower set, and connect it to the right hand upper set as shown. Loop the wire so that it clears the cover screws by 1/8 inch or more.

8. Connect the seven jumpers referred to in step 6 as shown in Fig. 4.





50 POSITION AMP CONNECTOR NOTE 1



NOTES:

1 SQUARED LETTERS ARE PIN CONNECTIONS AS SEEN FROM OUTSIDE OF CONNECTOR

2 MAGNET ARC SUPPRESSION DIODE POLARITY AS SHOWN IS STANDARD. REVERSED POLARITY IS OPTIONAL. CHECK MACHINE WIRING TO DETERMINE ACTUAL POLARITY.

Fig. 1. Schematic, BCD machine.

9. Relocate the wires that run from the connector to the taper pin blocks as shown in Table 1.

10. Any taper pins not disposed of in steps 6 and 9 are part of the interconnect from the operational and shift contacts. Disconnect them. If you are accustomed to working with either lacing cord or cable ties, the main harness may be unlaced between blocks A and B and the operational contacts, and the unnecessary wires removed. If this seems too difficult, they may be tied back to the harness. In either case, double-check that you haven't removed a necessary wire. This completes the rewiring of the character selection contacts.

11. Looking at the bottom of the machine, locate the operational contact assembly at the lower right. The earliest models had leaf-type contacts with soldered connections. The vast majority had a molded contact housing with wire-wrap pins protruding from the bottom.

12. Strip all wiring from the operational contacts. Locate and mark the wire that comes from the normally open contact of the C5 set. The C5 and C6 contacts are above the frame at the rear of the mechanism, with the C5 set closest to the motor. Double-check that C5's normally open contact is connected to pin b of the connector.

13. Make a "daisy chain" of wire-wrap clips with about 1 inch of hookup wire between them. Slip the clips over pin J of each set of contacts. Refer to Fig. 5.

14. Connect the previously identified wire from pin b onto any of the "J" pins.

15. Measure the length of wire required to reach from the operational contact assembly, pin L, to the connector.

16. Prepare five jumpers of the appropriate length, each with a male connector pin on one end and a wire-wrap clip on the other end.

17. Snap a connector pin into position z of the connector. Slip the wire-wrap clip over pin L of the tab contacts. In the same manner, connect pin AA to space, pin BB to back space, CC to return and DD to index.

18. Locate the shift transmit contacts. Do this by switching on your machine and looking at its right side. Shift to uppercase, then back to lowercase. Note that on the end of a shaft there is a round assembly that rotates during a shift but is sta-

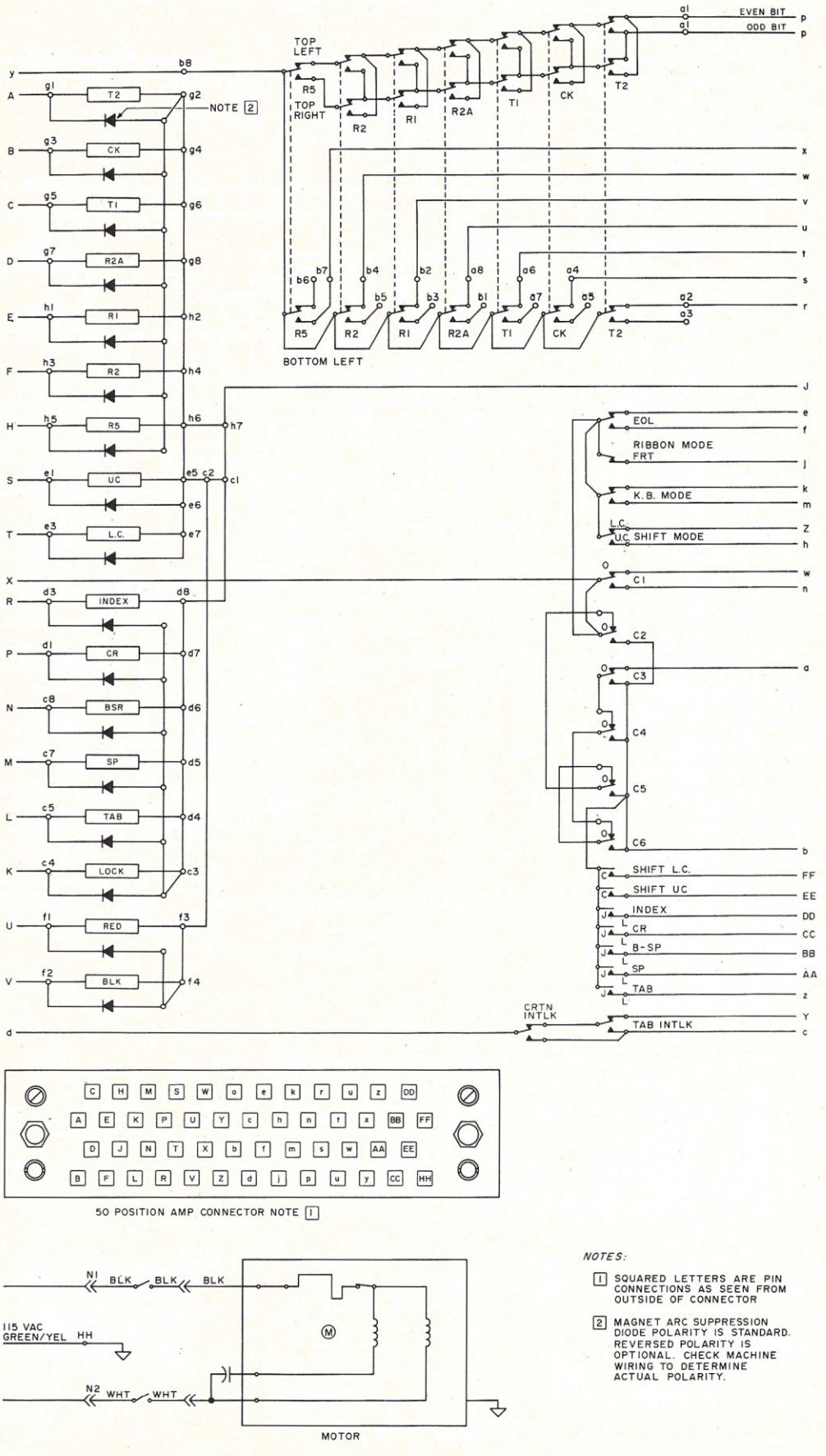


Fig. 2. Schematic, Correspondence machine.

tionary otherwise. This is called the *shift clutch*. Below and to the rear of the shift clutch are some contacts. Note that they move during a shift. The rearward group consists of three sets of single-pole, double-throw contacts. These are the shift transmit contacts. Note that there is a common connection to the swinging contacts of all three pairs.

19. Disconnect and tie back or remove all the wires connected to the shift transmit contacts.

20. Measure the length required to reach from the shift transmit common to one of the "J" pins on the operational contact assembly. Prepare a jumper with a wire-wrap clip at one end. Solder it to the shift transmit swinging contact common, and connect the other end to one of the "J" pins.

21. Measure the length required to reach from the shift transmit stationary contacts to the 50-pin connector. Prepare two jumpers, each with a connector pin at one end.

22. Connect one jumper to an inboard (toward the frame) stationary contact. Snap the connector pin into position EE of the connector. Connect the other jumper to an outboard stationary contact. Snap its connector pin into position FF of the connector.

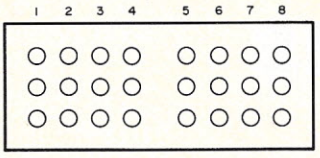


Fig. 3a. A typical taper pin block. The three connections under each number are connected together internally.

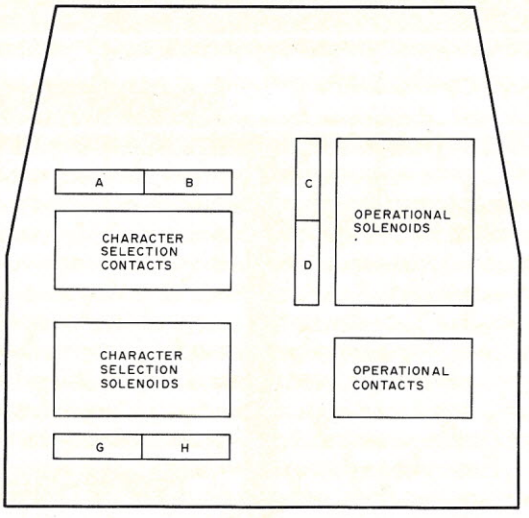


Fig. 3b. Locations of contact assemblies and taper pin blocks on bottom of machine.

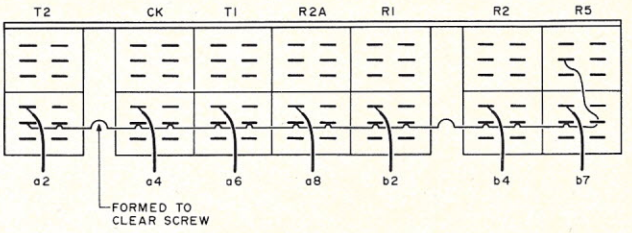


Fig 4. Character selection contacts.

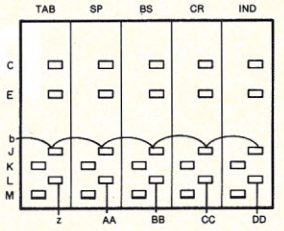


Fig. 5. Wire-wrap pins on operational contact assembly.

Modification Complete

This completes the modification. You are now the owner of a Correspondence-coded Selectric I/O typewriter. It will serve as a top-quality typewriter using any Correspondence typeball, and the electrical output of the keyboard is now Correspondence coded. You may take either of two approaches to interfacing the machine with your computer. It can be done entirely by using software, by providing code conversion lookup tables in memory. If a hardware approach appeals to you, there is a code conversion IC, from ASCII to Selectric and from Selectric to ASCII, available at a reasonable price (MCM6561, available from Tri-Tek, Inc.). Whichever method you use, this modification will transform your Selectric I/O from a printer with a useless keyboard into a fully functional hard-copy terminal. ■

IBM No. 241-5737-0	Service Manual	$7.85
241-5990-0	Adjustment Parts Manual	4.10
241-5188-9	Part Number/Price List	.45

Recommended reading.

Plucking Programs from Thin Air

Amateur radioteletype transmissions are an unusual source of new programs. Eavesdropping can be easy with a properly programmed 6800.

John J. Glidewell
3623 Charlene Dr.
Dayton OH 45432

Programs from thin air? Yes. By radioteletype. Radioteletype (RTTY) is used by many amateur radio operators (hams) to exchange messages and other types of data. Such transmissions are usually printed on a regular Teletype machine or on a video display. Many hams are also computer hobbyists, and program exchange by RTTY has become quite common.

Although you must be a licensed ham to transmit programs, anyone can receive them. Long-range transmissions use high-frequency (HF) radio, but two-meter FM radio (144.5–148 MHz) is being used more frequently for exchange of programs within the local area. Reception of these transmissions is the subject of this article.

Radioteletype

RTTY is accomplished by using two audio tones in exactly the same manner as is done by many computer tape systems. The common standard defines a mark as 2125 Hz and a space as either 2295 Hz (narrow shift) or 2975 Hz (wide shift). Narrow shift is normally used on the long-range HF bands, while wide shift is more common on the VHF bands. However, narrow shift is used locally on two-meter FM; therefore, the listed program will operate with either.

The various means by which transmission is accomplished are not germane to the immediate problem; however, a brief description of how RTTY reception and detection is accomplished is needed.

Output of a receiver tuned to an RTTY signal is the pair of audio tones. The tones are fed into a device called a terminal unit, or TU for short. The TU may contain amplifiers and limiters and a pair of narrow bandwidth audio filters, one tuned to each of the two audio tones.

The filters provide noise rejection and detection of the signal as either a mark or space. The output of the filters actuates a relay or some form of SPDT switch, one position of which represents the mark and the other position the space. The switch controls a standard 60 or 20 mA current loop to drive the printer directly. Thus, the TU acts like a computer I/O device and could replace a keyboard or other input device to enter data directly into the computer.

On the noisy HF bands, a fairly high-quality receiver and TU are needed for good performance. However, operation on the two-meter FM band has a couple of advantages. First, unlike most HF operations, the mark and space tones modulate the transmitter in such a manner that they will be reproduced correctly by the receiver even though it may be slightly off frequency, provided only that the signal remains within the passband of the receiver. Therefore, the highly stable receiver required on the HF bands is not mandatory with FM; although, of course, the better the receiver, the better the performance.

Second, FM reception is much more free of noise as long as a reasonable signal is received. These two items permit the elimination of the expensive TU and permit decoding of the mark-space tones to be done in software. The I/O interface device described here is simple and inexpensive, so the only item of any expense required for two-meter FM RTTY reception is a receiver, and you may already have a suitable one (more on that later).

At the time this is being written, amateur RTTY is restricted by the FCC to five-level Baudot code. I hope that ASCII will be approved soon since it is a far more satisfactory code for computer use. When ASCII is approved, I have a similar program all tested and ready to go. In the meantime, Baudot is the thing.

Even when ASCII is approved, I believe Baudot will still be extensively used because of the tremendous investment in terminal equipment. Even if the switch is made to ASCII for program transmission, there will still be a lot of interesting things going on in Baudot, one of which is called RTTY art in which pictures are transmitted. Last season I copied many nice Christmas pictures and posters using the program described.

Baudot in Miniature

Baudot consists of a start bit, five data bits and a stop bit. The five data bits are used to represent all 57 characters. Each code can represent either of two characters, a letter or a figure. The printer is told which of the two possible characters to print by a special shift code that is transmitted preceding

each string of characters of the same type. Carriage return, line feed and space, as well as the two shift codes, are common to both shift positions. If you are interested in a more detailed description of Baudot, as well as a listing of the codes, I refer you to the article by Haglund and Reed ("Baudot Interface Cookbook," *Kilobaud*, September 1978, p. 66).

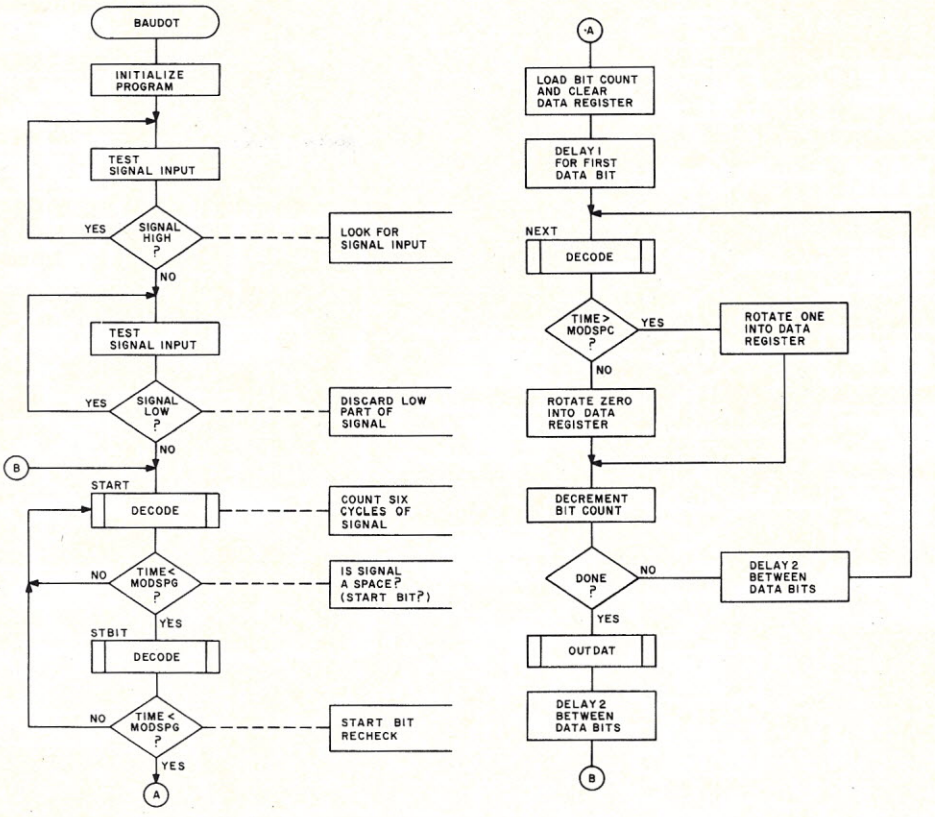


Fig. 1. Main program flowchart (continued on next page).

How It Works

The program listing was written specifically for the SWTP 6800 computer but should run on any 6800 machine provided I/O and monitor addresses are compatible or changed as necessary. The technique used, however, should be applicable to any computer, and I have included a flowchart of the main part of the program, as well as a detailed description, to permit a similar program to be written for other computers (see Fig. 1).

I will describe the first part of the program, Initialize Pointers, only briefly since it is unique to the 6800. Basically, this portion reads the program start address from memory and uses this data to find the location in memory of the various tables and messages. This was done solely to make the program relocatable and can be dispensed with if you want to use a fixed address. The program, as written, can be loaded anywhere as long as the LSB of the address is 00. The next program section merely programs the output ACIA to operate the printer.

The third section, Set Operating Parameters, provides flexibility by permitting the user to choose between several options. As mentioned earlier, the decode portion of the program will operate with either wide or narrow shift. This is accomplished by loading MODSPC with the appropriate value in accordance with the user's input.

Most Baudot transmission is at 60 wpm, although 100 wpm is increasing. Seventy-five wpm is more rare. The program permits these three-speed options by adjusting DELAY1 and DELAY2, which provide the appropriate baud rate timing in the computer. If your computer has baud rate signals of the proper values accessible in software, then you might want to make use of these.

The flowchart commences with the signal decode portion of the program. RTTY tones, in the form of square waves from the interface, are fed into a device on my computer called a control interface. This device is used to input serial data, although it is actually a parallel port—the serial-to-parallel conversion is in software. Input is fed to the high-order bit of the parallel port. By a shift-left instruction, the data is shifted into the carry register, which is queried to determine whether the input is high or low. Other machines can adopt their own methods of obtaining the same information.

With no signal input to the interface, the computer data bit will be high. The program remains in the top loop until an RTTY signal is detected by the input bit going low. Upon detection of the low, the program again loops in order to discard the first cycle of tone data which could be only a partial cycle.

Signal decoding actually starts at the label HRPT. A time counter, used to decode marks and spaces, is cleared, and an outer loop counter is set at six. The high- and low-signal loops operate as before, except now a counter is incremented on each cycle through the loop. Six complete cycles of the RTTY tone are counted to improve accuracy. I selected six cycles as a compromise between decode accuracy and the need to detect the beginning of a start bit for baud timing.

The two RTTY audio tones have different periods resulting in different time counts for a mark or space. Upon returning to the main program, the time count is compared with MODSPC. If the count is less than MODSPC, the signal is a space, or start bit. If not, the program loops back for another look. Transition between marking and a start bit can occur anytime, even during the middle of the six cycles counted. Therefore, DECODE is again entered for a confirming look.

With start bit received, the program clears a register to receive the incoming data and sets a counter to keep track of the five data bits. At 60 wpm each bit is 22 milliseconds long, and sampling should be done near the center. Therefore, the program must mark time from near the beginning of the start bit to the center of the first data bit. DELAY1 provides this. At the label NEXT, DECODE is entered five times. After each return, MODSPC is checked for mark or space, or, as I have labeled them, a one or zero. The appropriate bit is then shifted into the data storage register. After each bit a delay of slightly less than 22 msec is introduced by DELAY2.

Subroutine OUTDAT translates from Baudot to ASCII, prints the data and stores the data in memory. OUTDAT checks the data for a carriage return, line feed or space and generates the appropriate ASCII form. If the code is none of these, the program will look for a figure or letters shift and store the appropriate shift data. Shift information is not stored in memory, only ASCII data. Any remaining characters are data.

The array TABLE contains the ASCII codes arranged in the

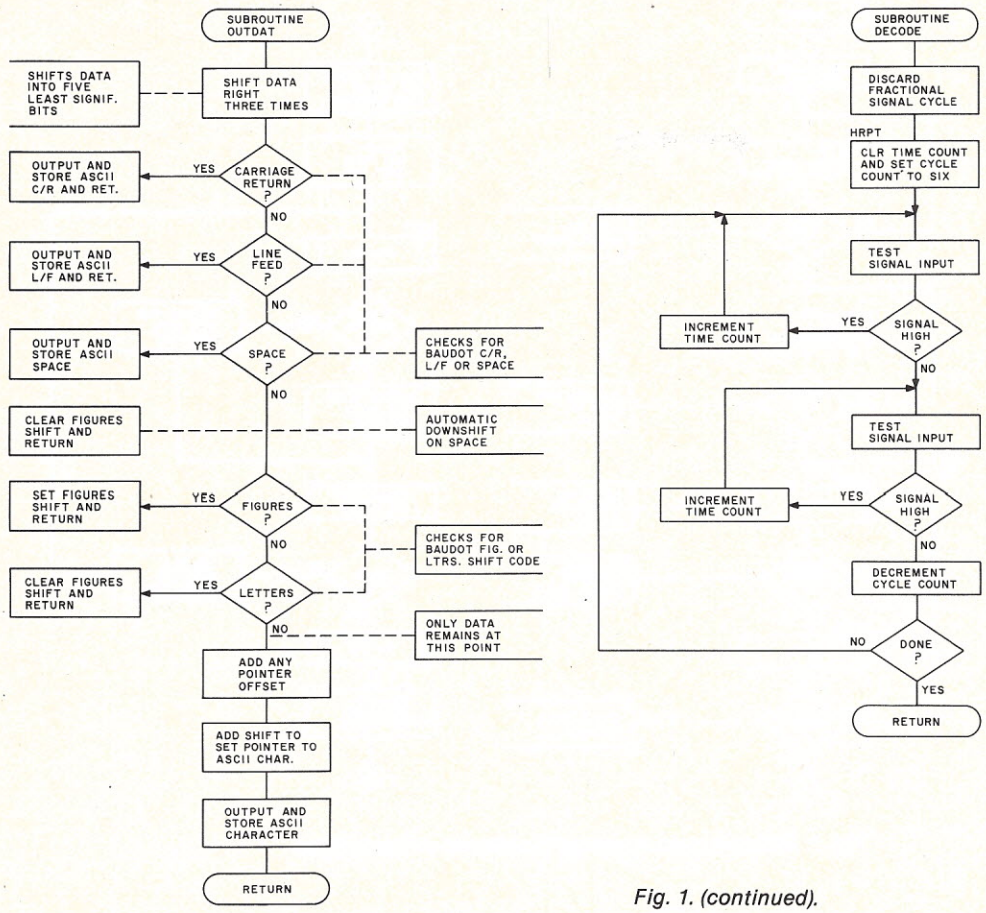


Fig. 1. (continued).

order of the corresponding Baudot code set. The input Baudot code itself then becomes the least significant half of the array pointer. The first 20 hex positions in TABLE contain ASCII letters, and the next 20 hex spaces contain the figures.

If the figures shift code has been received, a 20 hex will be stored in SHIFT and added to the pointer. If TABLE started at location XX00, then nothing more would be required. However, I loaded TABLE immediately following the program to save space. The actual location is found by adding an OFFSET to the Baudot code in addition to SHIFT.

The program uses the convention that reception of a space anywhere in the text will cause an automatic shift to Baudot letters mode, regardless of which shift was in use before (downshift on space). Upon receipt of a space, SHIFT is cleared to set letters mode.

Operation

In operation, the receiver is connected via its earphone or external speaker jack to the input of the interface. If your receiver connection mutes the internal speaker, you may want to add some sort of monitor across the line so you can hear the input signal. It is helpful if you can observe the output of the interface on a scope while adjusting radio volume and input gain control of the interface. You want to get an output that looks as clean as possible with little jitter. Don't mistake mark-space shifts as jitter. I have found best results with my particular system with receiver audio set near maximum and interface gain reduced to about the center of the control.

Before entering the program, be sure to load A048-49 with program start address, even if your monitor does not require it. On going to the program, you will be asked to enter wide or narrow shift, speed and save data option.

One caution: If you elect to save the data in memory, don't forget to enter memory storage address range into A002-A005 before going to the program; otherwise, you can wipe out your program. I know! Remember Glidewell's law: The more stupid the mistake, the longer it takes to find.

Once the specified field is filled, the program will halt, so give it enough room. The printer should now start printing.

I/O Interface

The interface circuit is shown in Fig. 2. The circuit is built around the same interface used for the tape recording systemin my article, "6800 Tape System" (*Kilobaud Microcomputing*, December 1979, p. 78), except the 7400 NAND gate has been replaced with a 74132 Schmitt trigger. The original circuit worked fine with narrow shift RTTY; however, when I went to wide shift, problems developed. These were caused by the limited audio bandwidth of the communications receiver that attenuated the high 2975 Hz tone. The 7900 op amp was added to provide some gain and limiting. Output of the 7900 is a chopped-off sine wave that is further squared in the 74132.

With no input signal, the output of the op amp is low. Since the RS-232 input on MP-C requires a low for no signal if the 20 mA loop section is being used, two sections of the 74132 are used to maintain the proper conditions.

If you are using only the 20 mA loop portion of the control interface, the circuit is connected directly to MP-C as shown in Fig. 2. Remove the ground strap from terminal RI and connect the interface directly in its place. Your system should work normally with no interaction between the two inputs on MP-C. If you are already using the RS-232 input (terminal RI) for another terminal, an SPDT switch, as indicated in Fig. 2 by the dashed lines, should be installed. After initializing the program, simply switch to the RTTY position.

The circuit is built on a two-IC board from Radio Shack (276-024). The cabinet is also from Radio Shack. Other parts came mostly from the junk box. I built a power supply in one of my duller moments. Current drain is so low, the 5 volts required could just as easily have

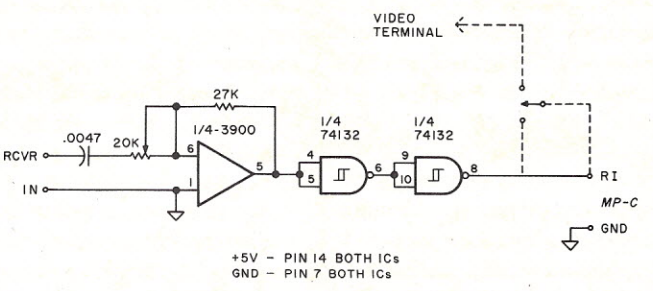


Fig. 2. The input interface circuit. The dashed lines are for an alternate connection if you already have another terminal connected to terminal RI on MP-C.

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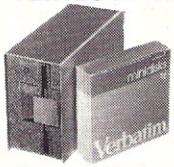

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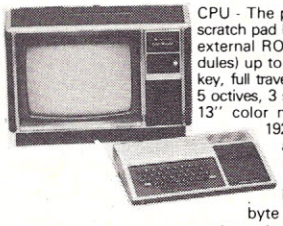

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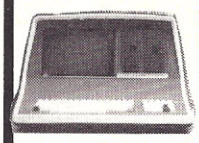

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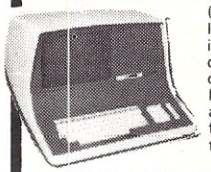

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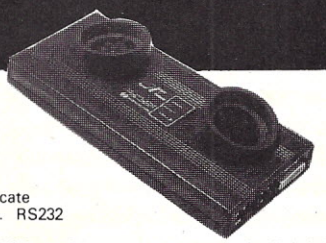

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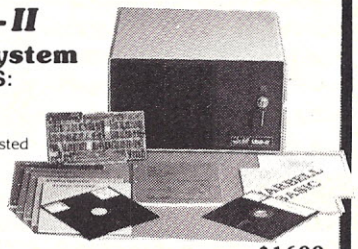

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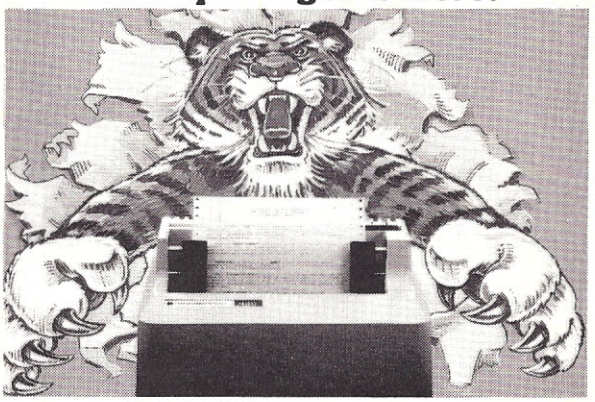

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come from the computer I/O board. I use this same circuit for the tape system previously referenced; hence I incorporated a switch and extra jacks for this function. Also included on my board is an interface for transmission of RTTY using computer-generated tones.

Modifications

The program listing contains delay values to suit the original SWTP 6800. The 68/2 has a different clock circuit that runs around one MHz, so certain timing changes are required. These changes are listed in Table 1. The 68/2 does not use a crystal clock and may be subject to some drift. Since timing is fairly critical, particularly in DECODE, you should make sure you stay as close to one MHz as possible.

If you are writing a program for another computer, you will have to compute your own delays. The required values for MODSPC can either be computed or found by experimenting. In this latter case, it helps to make a tape recording of each of the two (or three) audio tones. Play these tones into your version of DECODE and store the time count obtained after each sequence of six cycles. An examination of the results should provide a value for MODSPC. Select a point midway between the mark and space counts.

The program listing accepts input from a PIA on I/O board MP-C, but you can use a PIA in any I/O slot. To do this, one of the unused sections of the 74132 in Fig. 2 is added to the circuit in accordance with Fig. 3. You will have to change line 430 in the program listing to the address of the PIA. The extra program steps listed in Fig. 4 should be added to program the PIA as an input. Lines 1290 and 1300 of the original program can now be deleted as they are only used with the MP-C.

Output of the program is through a serial ACIA located in I/O slot three. Do not try to use the MP-C for output; it will not work. Otherwise, either serial or parallel output can be used. For an ACIA, change line 470, PRTDAT, to the appropriate address. If you plan to use a parallel port, the I/O routines in the program will have to be changed accordingly.

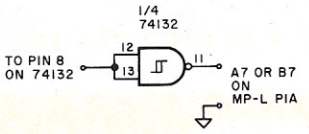


Fig. 3. Alternate connection for input to a PIA located in an I/O slot other than the control port.

If your printer is connected to an ACIA in the control port, I/O slot one, you have two choices. You can use the I/O routine in the program by changing line 470 to $8004 or you can use your monitor I/O routines with proper calls. One caution: using the monitor *may* cause trouble for a 110 baud printer when receiving at 100 wpm, particularly if your system has the 1.7971 MHz baud rate crystal.

Line No.	Change
0910	LDA A #$AC
0980	LDA A #$C2
1000	LDX #$0D4F
1020	LDX #$094E
1110	LDX #$0715
1130	LDX #$0527
1160	LDX #$0A6B
1180	LDX #$075A

Table 1. Program changes necessary with a 1 MHz clock. These are computed values, but should work.

The baud rate generated is slightly low, and your printer may occasionally get behind when copying a slightly fast transmission. Programming the ACIA for one stop bit avoids this. For printers with faster baud rates there will be no problem.

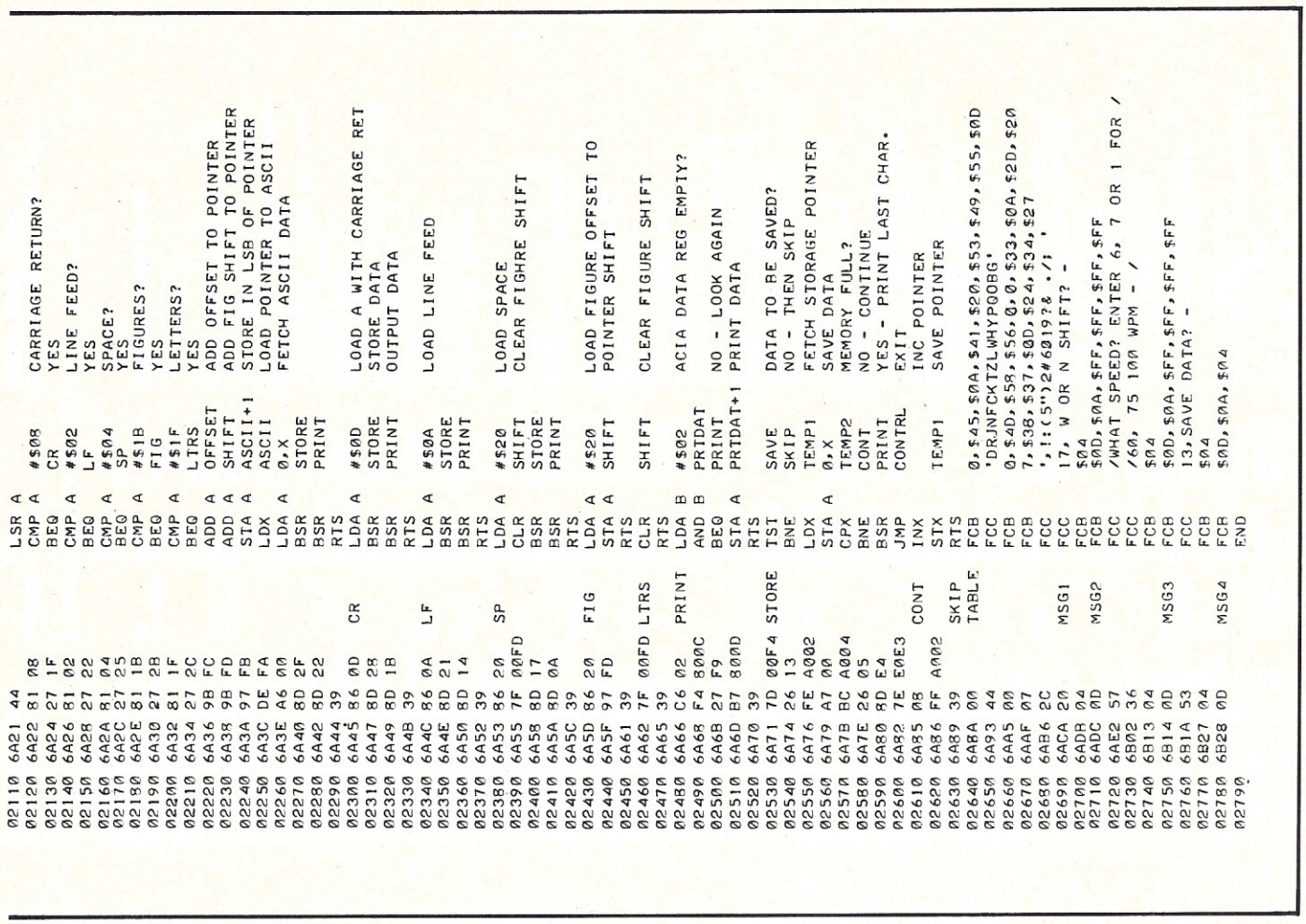
Receivers

You will need a two-meter (144.5–148 MHz) FM receiver. The first choice is a regular amateur receiver. Kits for five-

Program listing.

```
                    NAM   BAUDOT   VER 2.01 22 JAN 79
                  * J J GLIDEWELL   W9NKW
                  * RECEIVES 5 LEVEL BAUDOT - OUTPUTS ASCII
                  * DEMODULATES WIDE OR NARROW SPACE AFSK
                  * OPERATES AT 60, 75 OR 100 WPM
                  * PROGRAM WILL ASK FOR WIDE OR NARROW SHIFT
                  * ENTER W OR N - NO CARRIAGE RETURN
                  * ENTER SPEED AS REQUESTED
                  * RECEIVED DATA (IN ASCII) CAN BE SAVED IN MEMORY
                  * ENTER Y OR N TO SAVE/NOT SAVE DATA
                  * IF DATA IS TO BE SAVED, ENTER ADDRESS RANGE
                  * IN A002-A005 BEFORE GOING TO PROGRAM
                  * ALLOW SUFFICIENT MEMORY SPACE - PROGRAM WILL
                  * RETURN TO CONTROL IF MEMORY SPACE FULL
                  * ELEVEN MINUTES AT 60 WPM REQUIRES ABOUT 4K MEMORY
                  * INITIALIZATION IS THROUGH CONTROL PORT - SLOT 1
                  * INPUT IS THROUGH MP-C IN CONTROL PORT
                  * WITH ACIA IN CONTROL PORT, CHANGE INPUT TO PIA
                  * IN ANOTHER SLOT. CHANGE INPUT ADDRESS (LINE 430)
                  * AS REQUIRED.
                  * OUTPUT REQUIRES ACIA IN SLOT 3
                  * PROGRAM START ADDRESS MUST BE ENTERED IN
                  * A048-49 BEFORE PROGRAM IS RUN EVEN IF YOUR
                  * MONITOR HAS A GO TO PROGRAM
                  * PROGRAM CAN BE LOADED ANYWHERE IN MEMORY
                  * PROVIDED LSB OF START ADDRESS IS 00.
                        OPT   O,NOG
00EC              MSG11 EQU   $EC
00EE              MSG22 EQU   $EE
00F0              MSG33 EQU   $F0
00F2              MSG44 EQU   $F2
00F4              SAVE  EQU   $F4
00F5              MODSPC EQU  $F5
00F6              DEL1  EQU   $F6
00F8              DEL2  EQU   $F8
00FA              ASCII EQU   $FA
00FC              OFFSET EQU  $FC
00FD              SHIFT EQU   $FD
00FE              TEMP3 EQU   $FE
A002              TEMP1 EQU   $A002
A004              TEMP2 EQU   $A004
8004              INPUT EQU   $8004
E0E3              CONTRL EQU  $E0E3
E07E              OUT   EQU   $E07E
E1AC              IN    EQU   $E1AC
800C              PRTDAT EQU  $800C
6900              ORG   $6900
                  * INITIALIZE POINTERS
6900 8E A047      LDS   #$A047    SET STACK
6903 B6 A048      LDA A $A048     FETCH START ADDRESS
6906 4C           INC A           FIND MSB OF TABLES
6907 97 FA        STA A ASCII     INITIALIZE POINTERS
6909 97 EC        STA A MSG11
690B 97 EE        STA A MSG22
690D 4C           INC A
690E 97 F0        STA A MSG33
6910 97 F2        STA A MSG44
6912 CE 6ACA      LDX   #MSG1
6915 DF FE        STX   TEMP3
6917 96 FF        LDA A TEMP3+1
6919 97 ED        STA A MSG11+1
691B CE 6ADC      LDX   #MSG2
691E DF FE        STX   TEMP3
```

```
00670 6920 96 FF          LDA A  TEMP3+1
00680 6922 97 EF          STA A  MSG22+1
00690 6924 CE 6B14        LDX    #MSG3
00700 6927 DF FE          STX    TEMP3
00710 6929 96 FF          LDA A  TEMP3+1
00720 692B 97 F1          STA A  MSG33+1
00730 692D CE 6B28        LDX    #MSG4
00740 6930 DF FE          STX    TEMP3
00750 6932 96 FF          LDA A  TEMP3+1
00760 6934 97 F3          STA A  MSG44+1
00770 6936 CE 6A8A        LDX    #TABLE   FIND ASCII TABLE OFFSET
00780 6939 DF FB          STX    ASCII+1  STORE IN OFFSET
00790 693B 7F 00FD        CLR    SHIFT    SET SHIFT FOR LETTERS

00810              * INITIALIZE ACIA IN SLOT 3

00830 693E CE 800C        LDX    #PRTDAT
00840 6941 86 03          LDA A  #$03
00850 6943 A7 00          STA A  0,X
00860 6945 86 4D          LDA A  #$4D
00870 6947 A7 00          STA A  0,X

00890              * SET OPERATING PARAMETERS

00910 6949 86 97          LDA A  #$97
00920 694B 97 F5          STA A  MODSPC   SET FOR WIDE SHIFT
00930 694D DE EC          LDX    MSG11
00940 694F BD E07E        JSR    OUT
00950 6952 BD E1AC        JSR    IN
00960 6955 81 57          CMP A  #$57     WIDE OR NARROW SHIFT?
00970 6957 27 04          BEQ    S60      WIDE
00980 6959 86 AC          LDA A  #$AC     NARROW
00990 695B 97 F5          STA A  MODSPC   SET FOR NARROW SHIFT
01000 695D CE 0BF5 S60    LDX    #$0BF5   SET DELAYS FOR 60 WPM
01010 6960 DF F6          STX    DEL1
01020 6962 CE 0864        LDX    #$0864
01030 6965 DF F8          STX    DEL2
01040 6967 DE EE          LDX    MSG22
01050 6969 BD E07E        JSR    OUT
01060 696C BD E1AC        JSR    IN       INPUT SPEED
01070 696F 81 37          CMP A  #$37     75 WPM?
01080 6971 27 10          BEQ    S75      YES - BRA
01090 6973 81 31          CMP A  #$31     100 WPM?
01100 6975 26 16          BNE    SAV      NO - THEN IS 60
01110 6977 CE 065D S100   LDX    #$065D
01120 697A DF F6          STX    DEL1     100 WPM
01130 697C CE 04A2        LDX    #$04A2
01140 697F DF F8          STX    DEL2
01150 6981 20 0A          BRA    SAV
01160 6983 CE 095D S75    LDX    #$095D
01170 6986 DF F6          STX    DEL1     75 WPM
01180 6988 CE 069B        LDX    #$069B
01190 698B DF F8          STX    DEL2
01200 698D DE F0   SAV    LDX    MSG33
01210 698F BD E07E        JSR    OUT
01220 6992 BD E1AC        JSR    IN       SAVE DATA?
01230 6995 7F 00F4        CLR    SAVE
01240 6998 81 59          CMP A  #$59     YES?
01250 699A 27 03          BEQ    YEA      THEN SKIP
01260 699C 7C 00F4        INC    SAVE     NO - SET FLAG
01270 699F DE F2   YEA    LDX    MSG44
01280 69A1 BD E07E        JSR    OUT      OUTPUT C/R AND L/F
01290 69A4 86 3C          LDA A  #$3C     KILL ECHO ON CONTROL PORT
01300 69A6 B7 8007        STA A  INPUT+3

01320              * START OF RECEIVE PROGRAM

01340 69A9 0D      CH     SEC             CLEAR ANY FRACTIONAL
01350 69AA 79 8004        ROL    INPUT    CYCLES OF SIGNAL
01360 69AD 25 FA          BCS    CH
01370 69AF 0D      CL     SEC
01380 69B0 79 8004        ROL    INPUT    DISCARD LOW PORTION
01390 69B3 24 FA          BCC    CL       OF FIRST CYCLE
01400 69B5 8D 3B   START   BSR    DECODE   FETCH CYCLE TIME COUNT
01410 69B7 D1 F5   TEST    CMP B  MODSPC   IS IT A SPACE?
01420 69B9 23 04          BLS    STBIT    YES - GO MAKE SECOND COUNT
01430 69BB 8D 41   RPT     BSR    HRPT     NO - CHECK AGAIN
01440 69BD 20 F8          BRA    TEST
01450 69BF 8D 3D   STBIT   BSR    HRPT     MAKE SECOND TIME COUNT
01460 69C1 D1 F5          CMP B  MODSPC   SPACE?
01470 69C3 22 F6          BHI    RPT      NO - GO BACK AGAIN
01480 69C5 C6 05          LDA B  #5       YES - LOAD BIT COUNT
01490 69C7 37             PSH B           SAVE BIT COUNT
01500 69C8 4F             CLR A           CLEAR DATA SPACE
01510 69C9 36             PSH A           SAVE DATA SPACE
01520 69CA 8D 47          BSR    DELAY1   DELAY FOR FIRST DATA BIT
01530 69CC 8D 24   NEXT    BSR    DECODE   FETCH CYCLE TIME COUNT
01540 69CE D1 F5          CMP B  MODSPC   SPACE?
01550 69D0 22 0D          BHI    ONE      NO - THEN IS A ZERO
01560 69D2 32             PUL A           RECOVER DATA
01570 69D3 0C             CLC             CLEAR CARRY BIT
01580 69D4 46             ROR A           ROTATE ZERO INTO DATA
01590 69D5 33             PUL B           RECOVER BIT COUNT
01600 69D6 5A             DEC B           FIVE DATA BITS IN?
01610 69D7 27 13          BEQ    ASC      YES - GO TRANSLATE DATA
01620 69D9 37             PSH B           NO - SAVE BIT COUNT
01630 69DA 36             PSH A           SAVE DATA
01640 69DB 8D 3C          BSR    DELAY2   DELAY TO NEXT BIT
01650 69DD 20 ED          BRA    NEXT     GET NEXT BIT
01660 69DF 32      ONE    PUL A           RECOVER DATA
01670 69E0 0D             SEC             SET CARRY BIT TO ONE
01680 69E1 46             ROR A           ROTATE ONE INTO DATA
01690 69E2 33             PUL B           RECOVER BIT COUNT
01700 69E3 5A             DEC B           FIVE DATA BITS IN?
01710 69E4 27 06          BEQ    ASC      YES - GO TRANSLATE DATA
01720 69E6 37             PSH B           SAVE BIT COUNT
01730 69E7 36             PSH A           SAVE DATA
01740 69E8 8D 2F          BSR    DELAY2   DELAY TO NEXT BIT
01750 69EA 20 E0          BRA    NEXT     GET NEXT BIT
01760 69EC 8D 31   ASC     BSR    OUTDAT   GO OUTPUT DATA
01770 69EE 8D 29          BSR    DELAY2   DELAY FOR STOP BIT
01780 69F0 20 C3          BRA    START    RETURN FOR NEXT CHR
01790 69F2 0D      DECODE SEC
01800 69F3 79 8004        ROL    INPUT    CLEAR ANY FRACTIONAL
01810 69F6 25 FA          BCS    DECODE   CYCLES
01820 69F8 0D      HL     SEC
01830 69F9 79 8004        ROL    INPUT    CLEAR LOWS
01840 69FC 24 FA          BCC    HL
01850 69FE 5F      HRPT   CLR B           CLEAR TIME COUNT
01860 69FF 86 06          LDA A  #$06     SET CYCLE COUNT
01870 6A01 0D      HH     SEC
01880 6A02 79 8004        ROL    INPUT    FETCH INPUT
01890 6A05 5C             INC B           INC TIME COUNT
01900 6A06 25 F9          BCS    HH       INPUT HIGH? - THEN GO BACK
01910 6A08 0D      HLS    SEC             INPUT LOW
01920 6A09 79 8004        ROL    INPUT    FETCH INPUT
01930 6A0C 5C             INC B           INC TIME COUNT
01940 6A0D 24 F9          BCC    HLS      INPUT LOW? - THEN GO BACK
01950 6A0F 4A             DEC A           DEC CYCLE COUNT
01960 6A10 26 EF          BNE    HH       DONE? -NO- COUNT NEXT CYCLE
01970 6A12 39             RTS             YES - RETURN
01980 6A13 DE F6   DELAY1 LDX    DEL1
01990 6A15 09      D1     DEX             DELAY FOR FIRST DATA BIT
02000 6A16 26 FD          BNE    D1
02010 6A18 39             RTS
02020 6A19 DE F8   DELAY2 LDX    DEL2
02030 6A1B 09      D2     DEX             DELAY BETWEEN BITS
02040 6A1C 26 FD          BNE    D2
02050 6A1E 39             RTS

02070              * DECODE BAUDOT TO ASCII

02090 6A1F 44      OUTDAT LSR A           SHIFT DATA TO FIVE LEAST
02100 6A20 44             LSR A           SIGNIFICANT BITS
```



```
02110 6A21 44                LSR A
02120 6A22 81 08             CMP A  #$08      CARRIAGE RETURN?
02130 6A24 27 1F             BEQ    CR        YES
02140 6A26 81 02             CMP A  #$02      LINE FEED?
02150 6A28 27 22             BEQ    LF        YES
02160 6A2A 81 04             CMP A  #$04      SPACE?
02170 6A2C 27 25             BEQ    SP        YES
02180 6A2E 81 1B             CMP A  #$1B      FIGURES?
02190 6A30 27 2B             BEQ    FIG       YES
02200 6A32 81 1F             CMP A  #$1F      LETTERS?
02210 6A34 27 2C             BEQ    LTRS      YES
02220 6A36 9B FC             ADD A  OFFSET    ADD OFFSET TO POINTER
02230 6A38 9B FD             ADD A  SHIFT     ADD FIG SHIFT TO POINTER
02240 6A3A 97 FB             STA A  ASCII+1   STORE IN LSB OF POINTER
02250 6A3C DE FA             LDX    ASCII     LOAD POINTER TO ASCII
02260 6A3E A6 00             LDA A  0,X       FETCH ASCII DATA
02270 6A40 8D 2F             BSR    STORE
02280 6A42 8D 22             BSR    PRINT
02290 6A44 39                RTS
02300 6A45 86 0D       CR    LDA A  #$0D      LOAD A WITH CARRIAGE RET
02310 6A47 8D 28             BSR    STORE     STORE DATA
02320 6A49 8D 1B             BSR    PRINT     OUTPUT DATA
02330 6A4B 39                RTS
02340 6A4C 86 0A       LF    LDA A  #$0A      LOAD LINE FEED
02350 6A4E 8D 21             BSR    STORE
02360 6A50 8D 14             BSR    PRINT
02370 6A52 39                RTS
02380 6A53 86 20       SP    LDA A  #$20      LOAD SPACE
02390 6A55 7F 00FD           CLR    SHIFT     CLEAR FIGHRE SHIFT
02400 6A58 8D 17             BSR    STORE
02410 6A5A 8D 0A             BSR    PRINT
02420 6A5C 39                RTS
02430 6A5D 86 20       FIG   LDA A  #$20      LOAD FIGURE OFFSET TO
02440 6A5F 97 FD             STA A  SHIFT     POINTER SHIFT
02450 6A61 39                RTS
02460 6A62 7F 00FD     LTRS  CLR    SHIFT     CLEAR FIGURE SHIFT
02470 6A65 39                RTS
02480 6A66 C6 02       PRINT LDA B  #$02      ACIA DATA REG EMPTY?
02490 6A68 F4 800C           AND B  PRIDAT
02500 6A6B 27 F9             BEQ    PRINT     NO - LOOK AGAIN
02510 6A6D B7 800D           STA A  PRIDAT+1  PRINT DATA
02520 6A70 39                RTS
02530 6A71 7D 00F4 STORE     TST    SAVE      DATA TO BE SAVED?
02540 6A74 26 13             BNE    SKIP      NO - THEN SKIP
02550 6A76 FE A002           LDX    TEMP1     FETCH STORAGE POINTER
02560 6A79 A7 00             STA A  0,X       SAVE DATA
02570 6A7B BC A004           CPX    TEMP2     MEMORY FULL?
02580 6A7E 26 05             BNE    CONT      NO - CONTINUE
02590 6A80 8D E4             BSR    PRINT     YES - PRINT LAST CHAR.
02600 6A82 7E E0E3           JMP    CONTRL    EXIT
02610 6A85 08          CONT  INX              INC POINTER
02620 6A86 FF A002           STX    TEMP1     SAVE POINTER
02630 6A89 39          SKIP  RTS
02640 6A8A 00          TABLE FCB    0,$45,$0A,$41,$20,$53,$49,$55,$0D
02650 6A93 44                FCC    'DRJNFCKTZLWHYPQOBG'
02660 6AA5 00                FCB    0,$4D,$58,$56,0,0,$33,$0A,$2D,$20
02670 6AAF 07                FCB    7,$38,$37,$0D,$24,$34,$27
02680 6AB6 2C                FCC    ',!:($")2#6019?& ./;'
02690 6ACA 20          MSG1  FCC    17, ' W OR N SHIFT? -
02700 6ADB 04                FCB    $04
02710 6ADC 0D          MSG2  FCB    $0D,$0A,$FF,$FF,$FF,$FF
02720 6AE2 57                FCC    /WHAT SPEED? ENTER 6, 7 OR 1 FOR /
02730 6B02 36                FCC    /60, 75 100 WPM - /
02740 6B13 04                FCB    $04
02750 6B14 0D          MSG3  FCB    $0D,$0A,$FF,$FF,$FF,$FF
02760 6B1A 53                FCC    13,SAVE DATA? -
02770 6B27 04                FCB    $04
02780 6B28 0D          MSG4  FCB    $0D,$0A,$04
02790                        END
```

or six-channel receivers are available for about $60 to $70. These are crystal controlled so a crystal for each frequency used will also be required. Consult the various ham magazines such as *73 Magazine*.

Another choice is one of the many PSB Hi band VFH scanners around. These are often excellent receivers, and many cover at least the important portion of the two-meter band, 146–148 MHz. Even if their coverage is listed only down to 148 MHz, most will operate at the lower frequencies. Many hams use these for monitors.

The last choice is one of the tunable PSB receivers. Their main advantage is you can tune to find RTTY signals, recognizable by their chirping sound. Their main disadvantage is lack of sensitivity and poor selectivity. This means that in the populated areas where there are many stations, interference is likely. Also their poor sensitivity, particularly in the lower-priced receivers, requires a stronger signal.

```
0430  INPUT EQU $(NEW ADDRESS)
0811  LDX #INPUT
0812  CLR O,X
0813  LDA A #4
0814  STA A 1,X
```

Fig. 4. Program additions for use with a PIA, other than the MP-C, for input.

If you already have a good communications-type shortwave receiver with an FM detector, another possibility is to add a converter. Converter kits are available for under $40. This method has the advantage of requiring no crystals, and you can tune the entire two-meter band.

Reliable range of two meters depends largely on the antenna height of both transmitter and receiver. When two stations are communicating directly to each other, alternately using the same frequency (Simplex), range may vary from a few miles to 10 or 20 miles, although much longer ranges are obtained. A repeater is a device that receives a signal and retransmits it on a different frequency, usually with higher power and from a better antenna location. Through repeaters, ranges of maybe 30 to over 100 miles are usual. Many localities now have RTTY repeaters operating.

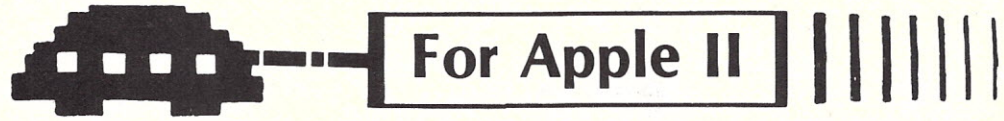
How do you find the frequency(s) used for RTTY? The best way is to ask a ham. Our local computer club has a dozen or more ham members, so try your club. If you don't know any hams, maybe a friend does. With a tunable receiver, you can listen. If all you hear is voice, keep listening, particularly in the early evening. Even RTTY repeaters are used more for voice than RTTY. If yours is a crystal-controlled set, then you must find the frequency in order to obtain the proper crystals.

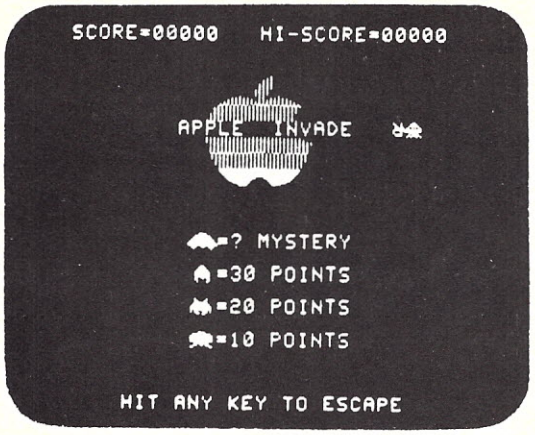
Some Possibilities

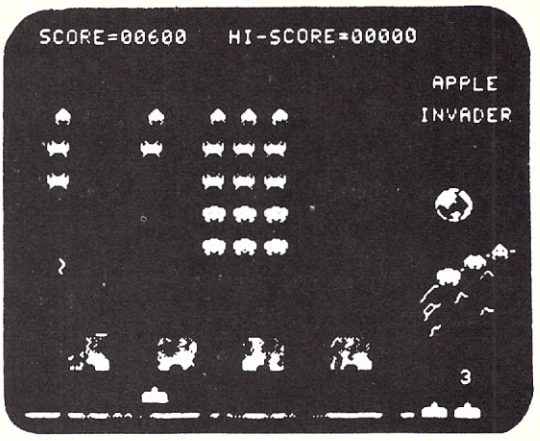
Amateurs are not permitted to broadcast one-way signals, so a ham buddy cannot legally send to you, a non-ham. But suppose a couple or more hams in the computer club arrange a schedule to transmit programs back and forth to each other at 8 PM Tuesday. There is no reason you shouldn't eavesdrop, and if you cannot hear one of them, possibly the other is on your side of town.

Programs can be stored on tape instead of being printed. They can then be loaded into the computer or printed from the tapes. It makes no difference what your tape baud rate is; it will simply take much more tape than usual because of the low speed of incoming data.

If anyone would like to try this program but doesn't want to key it in by hand, I can furnish an object tape for $4. Please specify starting address of 0100, 2000 or 6900. Alternately, I could provide a tape copy of the assembler program for the SWTP Co-Res Assembler. All tapes are 300 baud KC. ■







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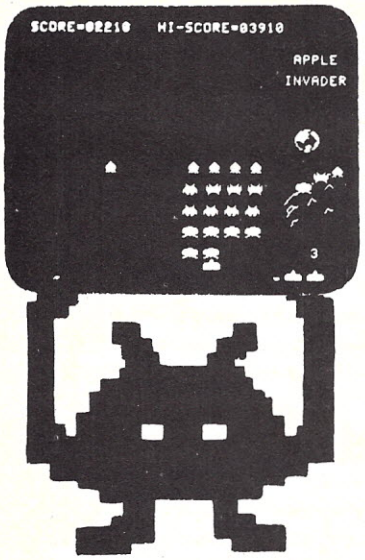

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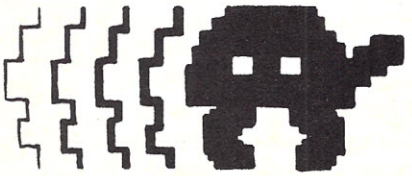

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A personal computer is much like a Barbie doll—once you have purchased the bare unit, the price of wardrobe and accessories can easily equal or surpass the original price tag! Small wonder the new microcomputer owner feels intimidated by the vast array of hardware and accessories available for his system.

Like you, I studied specification sheets for quite a while before purchasing my Apple II. The standard features included are impressive, but by no means complete. My applications are different than yours, so our systems must be configured differently. The standard 16K Apple II can do a lot of processing, but you must have a TV monitor (or modulator) to see what it's doing and a cassette unit to store what it has done. Perhaps your dealer included the cassette recorder and modulator in the price; if not, you have already started the process of accessory purchasing.

Once you have played the standard game a few times and (I hope) studied the excellent documentation supplied by Apple, you will probably be itching to begin your own applications. If you purchased your Apple II with full 48K RAM, disk drive(s), I/O cards, modem,

Survey results.

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California Digital
4738 156th Street
Lawndale CA 90250
(213)679-9002 8:30-5 PST
MC, VISA/M.O.-none/Cat-Free
90-day guarantee

- NEC UPD416D 16K memory chip set 8/$65
- Digicast AV/100 rf modulator $29.95

Candex Pacific, Inc.
693 Veterans Blvd.
Redwood City CA 94063
(415)364-8427 9-6 PST
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(data free) 30-day guarantee

- Tape activator controls audio tape recorder from the game I/O connector. Can control other devices not exceeding ½ Amp current. Has connector for game controls or another activator. Each model addressed by a different POKE command, if multiple units are used each must be a different model. Model numbers: 100-00; 100-01; 100-02; 100-03. $39.95

Circuit Specialists
1344 North Scottsdale Rd. (Box 3047)
Tempe AZ 85281
(800)528-1417
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- Pkg. of eight 4116 16K memory chips $159.95
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Memory chips 100 percent guaranteed.

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- ICs, components.

printer, etc., this article may be only of passing interest to you. I suspect (from personal experience and an informal survey of owners in our local Apple users group) that most computer hobbyists start out with a "plain Jane" system and the intention of adding hardware and accessories as interests develop and finances permit. Many of us in the latter group (you know—the ones unable or unwilling to commit several kilobucks to our initial purchase) have now reached the point of looking for ways to expand the capabilities of our systems.

Many applications require additional hardware (and software) of a specialized nature. Amateur radio, for instance, could use audio-to-digital converters, antenna rotor controls, ASCII-to-five-level conversion, logging systems, repeater control and ac controllers, to mention only a few of the countless possibilities. Someone in the diverse group of Apple owners and accessory designers has probably worked up items that will be of direct use in your application, but where do you find out about them?

Sources of Information

Computer manufacturers publish a great deal of information about their products. Apple literature describes not only the basic system, but also numerous accessories available from dealers. You probably studied some of this literature in reaching your decision to purchase the Apple II and are already aware of most items offered by Apple. Unless your literature is quite recent, you may have missed some, since new items are continually being added to the Apple line.

The Heuristics SpeechLab is one of the many accessory items offered for the Apple II. (Photo courtesy of Heuristics, Inc.)

Your local computer emporium can be a great source of information. Most manufacturers maintain a mailing list of dealers and send literature on new products as they become available. I'm sure your dealer would be happy to watch for product announcements of specific interest to you.

If you are fortunate enough to live in an area that has an Apple users group, much valuable information is available. Chances are some of the other members have interests similar to yours and will be willing to work together on applications. A file of literature received by various members of the group would be a good source for information on hardware and accessory items.

Magazines, newsletters and direct-mail advertising are all directed toward disseminating information about available new products. Manufacturers spend a great deal of money attempting to inform you of the items they have to offer, but obviously cannot advertise each product in every issue of every publication. Many magazines offer reader service cards, which enable you to obtain literature on specific products. If you don't see the particular company listed that interests you, a letter request will usually bring a catalog by return mail. Some companies request an SASE or small fee for their literature; this is usually noted in their advertisements.

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- 16K dynamic RAM chips (250 ns) 8/$89.95
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Lifetime guarantee

- National 4116 16K RAM chips (250 ns) $8
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- Hitachi 16K memory expansion set $140 (also available through many retail dealers).

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- UPD416 (MK4116) 16K RAM chips $14.95
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- Apple II to Superkim downloading card with cable and connector (MP9102-2) $74.95

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Survey

This survey was undertaken with a primary motive in mind—I was interested in some accessory items for my Apple II and wanted to see what was available and from whom. It occurred to me that other Apple owners might be in the same situation, thus this article.

I have attempted to provide a reasonably compact and complete list of hardware and accessory items most likely to be added by the hobbyist with a relatively bare Apple II. I made no attempt to locate all items compatible with RS-232, current loops, parallel and serial ports, etc.—the list could be endless! I included only those items advertised as being designed specifically for the Apple II. Since information on products manufactured by Apple Computers, Inc., should be readily available to all owners, I did not include these in this listing.

It should be emphasized this article is in no way intended to duplicate the advertising efforts of any supplier; it merely provides a compact listing of items and sources from which you can obtain specific information regarding them. I have attempted to answer for you the same kinds of questions we all have when dealing with any supplier.

Survey Procedure

A questionnaire was sent to as many sources as I could locate from magazine ads, direct-mail fliers and catalogs. As mentioned earlier, I included only those suppliers indicating hardware or accessories for the Apple II.

Forty-five questionnaires were mailed, and 27 were returned within four weeks . . . a response rate of 60 percent. Much supplementary information in the form of literature sheets, catalogs and product information was received and used to provide the information contained in the listings.

Certainly there are suppliers not mentioned in this article for various reasons—questionnaires not returned, names and

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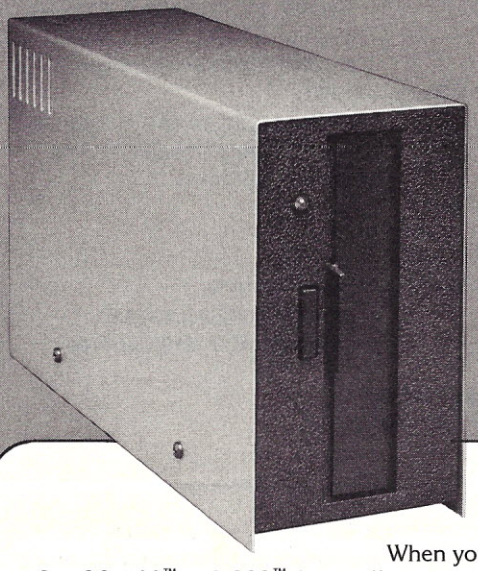

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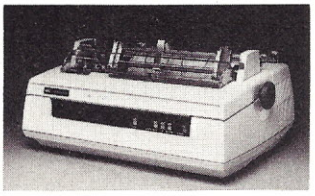

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addresses not located in the initial search, products recently developed and marketed. If you know of (or are) a supplier not listed, please send me as much information as you can so the listings can be expanded and updated at a later time.

Listing Format

The listings that follow are set up alphabetically and contain the following information:

Name	Number and hours for phone orders
Address	Credit Cards Accepted/ Minimum Order/Catalog
City, State, Zip	Guarantee (if offered) Terms

- Items offered (brief description and price).

Information in the listings has been taken from questionnaire responses and/or condensed from catalog descriptions provided by each supplier. Accuracy of the information is *not guaranteed*, and you should investigate further prior to actual purchase of any item described. *None* in any category indicates no information received regarding that item.

Peripherals Unlimited — (213)595-6858 9-5 PST
2633 E. 28th St. Suite 622 — ? CC/M.O.-none/Cat-SASE
Signal Hill CA 90806 — 90 days labor, 1 year parts.

- Universal parallel card—intelligent I/O control, configuration of I/O can be changed to meet particular needs via user programmable driver with battery back-up. Software inc. $179.95
- Also carries the lowercase adapter.

Powersoft, Inc. — (Products sold to dealers only)
PO Box 157 — Catalog on request
Pitman NJ 08071

- Light pen (ZXX 0003)—plugs directly into game I/O connector. Supplied with demonstration software. $34.95

Priority 1 Electronics — (800)423-5633 (Cal. 213-894-8171)
16723 Roscoe Blvd. — 8-6 PST MC, VISA/M.O.-$10/Cat-Free with order. Chips meet or exceed manufacturers specs
Sepulveda CA 91343

- 16K memory expansion kit (200-250 ns) $69

The CPU Shop — (617)242-3350 9-7 M-F, 9-6 Sat. EST
39 Pleasant Street — MC, VISA/M.O.-none/Cat-Free
Charlestown MA 02129 — 90-day guarantee

- NEC UPD416D 16K (300 ns) 8/$85
- NEC UPD416-1 16K (250 ns) 8/$87
- NEC UPD416D-2 16K (200 ns) 8/$89
- Dealer for complete Apple line and related software.

Tri-Tek — (602)995-9352 9-5:30 M-F
7808 N. 27th Avenue — MC, VISA/M.O.-$10/Cat-Free
Phoenix AZ 85021

- NEC UPD416 16K (300 ns) $18, 8/$128
- NEC UPD416-2 16K (200 ns) $20, 8/$144
- IC, components.

Summary

I have made no attempt to judge the quality of either products or vendors in this article. When considering the purchase of any additional items for your Apple II, you should:

1. Carefully read the description so you know exactly what you're buying.
2. Check with your local dealer. Perhaps he has, or would be willing to get, a unit you could see prior to making your decision.
3. Ask around. Other hobbyists in the area may have dealt with the supplier involved and be able to tell you something about the quality of products available.
4. Look through your back issues of this and other magazines. Someone may have reviewed the particular item at a time when you weren't in the market and didn't pay much attention. (If you don't find a review and decide to purchase the item, how about writing one? It's easier than you think and could help defray the cost!)
5. Don't hesitate to request more detailed information from either your dealer or the manufacturer. Manuals are often available separately for a nominal cost and provide more detailed information than a spec sheet or catalog description can provide.
6. Carefully read the guarantee (if one is offered) and question any provisions you don't understand.
7. Caveat emptor! (Let the buyer beware!)■

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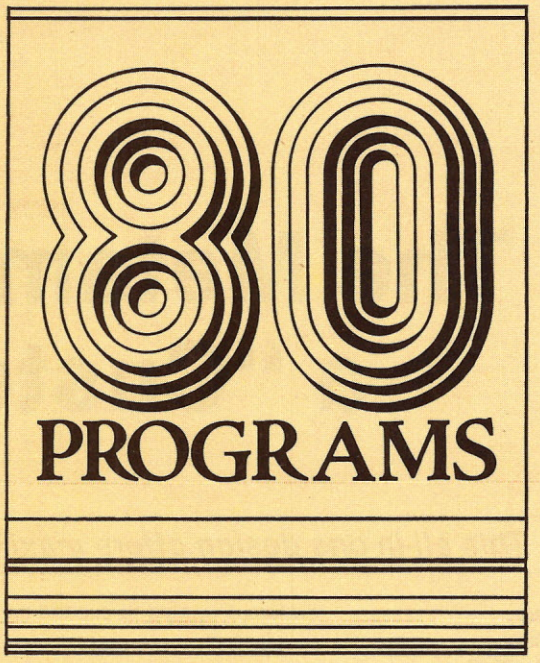

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The Metamorphosis of a "Custom" PET

This all-in-one design offers maximum portability in a disk-based PET.

Robert Freeman
Penn Park J-382
Morrisville PA 19067

Almost everyone is familiar with the PET computer from Commodore; it is one of the most popular "appliance-type" computers and features a built-in video display and cassette recorder. The PET uses the 6502 microprocessor and Microsoft BASIC—the fastest combination around.

But like many computer owners, I soon became impatient with the slow cassette recorder. Also, like many other computer owners, I wanted to expand my system to include more memory, more I/O, etc. But I still wanted a single compact unit such as the original PET. That started me thinking about a "custom" PET, with a built-in floppy disk system and extra memory.

Considerations

1. I wanted to maintain the portability of my PET.
2. I wanted the disk on the front for easy access.
3. I would only use the cassette recorder occasionally once I had the disk installed.
4. I wouldn't need the PET keyboard, as I had already built an external keyboard.
5. I needed room to mount a floppy disk drive (or drives), floppy disk controller, memory expansion, power supply for the disk drive and control boards. I needed more physical space for expansion.

I then had to consider other limitations: lack of hard cash. I could supply the effort and the metal bending, but where could I get an economical disk controller and software to run my disk? And how could I increase memory capacity for a reasonable cost?

After looking around a while, I found there wasn't much choice. The only company that sold a separate disk controller board for the PET was CGRS Microtech, Inc., of Southampton PA. This turned out to be an excellent choice since the CGRS Microtech board (EXS100) is actually two boards in one: a disk controller and PET-to-S-100 adapter (see Fig. 1).

The board is the size of the standard S-100 card, with the disk controller (and ROM space) using the upper half of the board and the S-100 adapter for memory expansion on the lower half of the board. The cost of this card assembled and tested was $299 for the disk controller and cassette software. Their ROM version of software (by Wilserv Industries, PO Box 115, Haddonfield NJ 08033), which I purchased, was an additional $60 (see Photo 1).

With the CGRS Microtech S-100 memory expansion adapter, I was able to buy inexpensive memory as needed, add all kinds of extra I/O and many sophisticated types of S-100 cards and have hardware and software to support three disk drives.

With most of the pertinent facts in mind, I was now ready to start my planning and design.

Decisions, Decisions

My initial design decisions included using the CGRS controller, beginning with one disk drive, using a 5 slot (S-100) motherboard, adding 16K extra

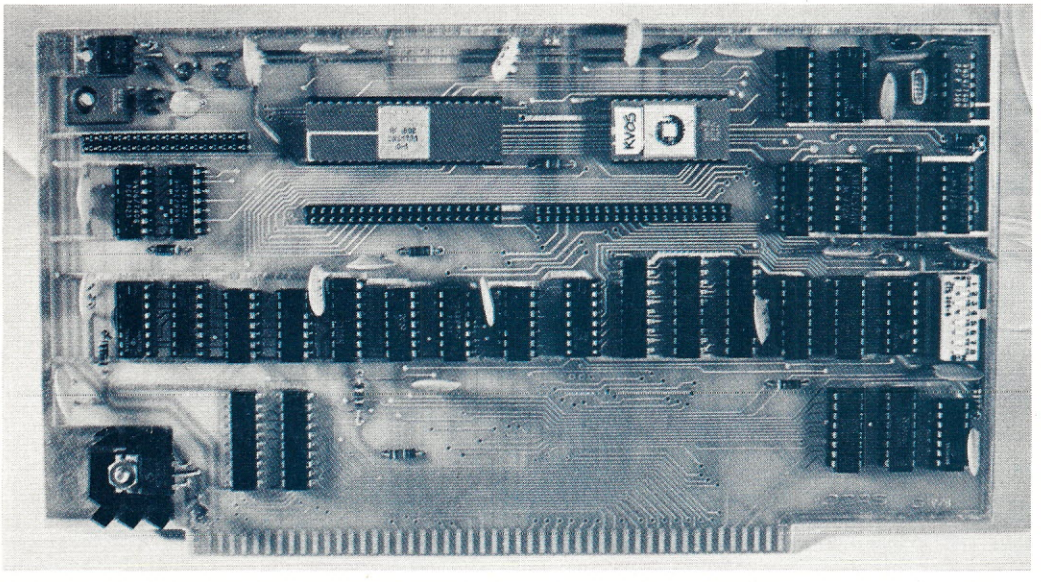

Photo 1. The CGRS Microtech disk controller board showing the PET-to-S-100 adapter and disk controller section.

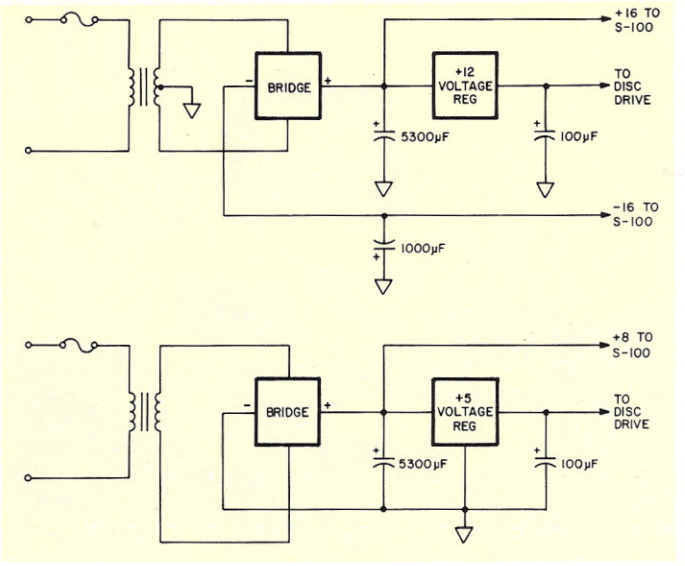

Fig. 1. Power supply for both disk and S-100. (Parts purchased from AB Computers, 115 East Stump Rd., Montgomeryville PA 18936.)

Photo 2. Original PET with CGRS PE disk system.

memory, using an external keyboard and eliminating the tape cassette from the front and plugging it in back when I needed it.

The next big decision I made was to eliminate the sloped front and make a new top cover for the PET, but leave the rest of the sheet metal as it was. Now, this may seem to you like a rather strange way to treat a PET, but I wanted to have the extra room.

Before making the final decision to start construction, I went to CGRS Microtech to see their complete disk system in operation. I was surprised to learn their controller card would also, with a few jumper changes, operate eight inch disks (see Photo 2) as well as the minidisks. The system they let me use consisted of their standard disk package with two eight inch disks. I was pleased to find it simple to use and foolproof in its operation.

New Cover

I made the case out of a piece of 1/16 inch thick aluminum (27 inches wide × 29 inches long) that I cut out and bent in four places so it would fit directly onto the original PET hinge and open the same way as the original PET case opens.

Then, instead of leaving a large hole in the top between the PET and the CRT, I made a small hole to run wires down from the CRT and a hole for a fan to draw the air through the CRT into the bottom of the case. Proper ventilation is important in the original PET. A fan is almost necessary there.

I moved the power transformer from the base to the back wall (back of PET, lower half). Then, I replaced the part of the PET that held the tape deck and keyboard with my square box. That made my PET about one inch taller. Instead of sloping down at front for the keyboard, it comes straight across and is the same size as the original PET box.

Between the main logic board and the left-hand side of the PET, there was room for a five slot S-100 motherboard (where the cassette used to be) as well as the disk controller card, memory cards and several other S-100 cards. The fan is mounted horizontally between the CRT housing and the new case to provide ventilation to all the electronics.

I already had replaced the original keyboard with a full-size keyboard, so there was no need for the PET keyboard. This left room to put three drives in the new enclosure. Right now I only have one disk drive, which is mounted horizontally so it looks better. I will mount future drives vertically, so I will have space for a total of three while still keeping the PET in one compact, portable, easy-to-move-around package.

Power Supply

The power supply drives the disk and the S-100 board. It requires +8 volts at 5 Amps, ±16 volts at 3 Amps for the S-100 bus, +5 volts at 2 Amps and +12 volts at 2 Amps for the disk. I assembled the power supply with parts that were on hand or readily available for less than $30. A complete power supply kit is available from CGRS for $55. The power supply is mounted in the upper corner of the new box behind the Shugart drive.

Assembly

The assembly went together well. The cables for the S-100 expansion system (Photo 3) connect to the PET memory expansion port and run underneath the PET main logic board, up alongside of the S-100 motherboard, and plug into the CGRS EXS100. Another cable connects the EXS100 to the Shugart disk drive. Two more cables connect the S-100 motherboard and the Shugart drive to the power supply.

You may notice the small circuit board in the right-hand rear corner of the PET. It has nothing to do with the disk; it is a small amplifier for sound. When software has sound built in, I don't

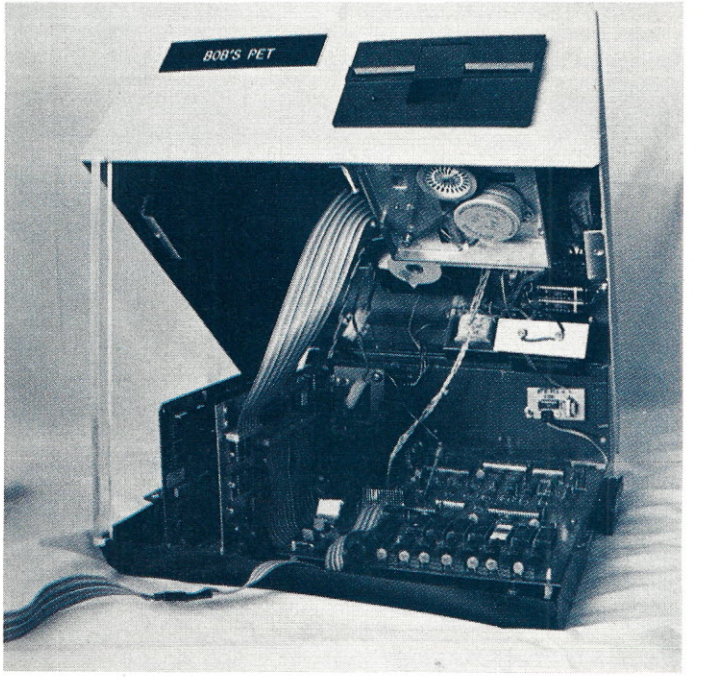

Photo 3. Internal assembly of Bob's PET.

Photo 4. Completed "custom" PET.

have to carry a separate amplifier and speaker with me because it's also built right into my PET.

Ease of Operation

The software from Wilserv Industries is great! You may operate it two ways: from BASIC or from its own monitor. From BASIC you can:

a. Save a program
b. Load a program
c. Run a program
d. Write a sequential data file
e. Read a sequential data file
f. List the disk directory
g. Update a program
h. Delete a program
i. Initialize a new diskette
j. Compress a diskette (physically recover space from a deleted program)

From the disk monitor, which is invisible to the BASIC user, you can:

a. Perform all of the above BASIC commands
b. Save assembly-language programs
c. Load assembly-language programs
d. Alter the file load point
e. Move blocks of memory
f. Echo the console character
g. Go to any location in memory
h. Move programs from disk to disk

Move Utility

Move is used to make backup diskettes or to copy programs from disk to disk. The interesting point is that it will work with a single disk drive or a multiple disk-drive system. Its operation follows along logically, so it will not let you make any errors in copying.

The disk directory may be listed in short form (program names only) or long form. The long form lists the program name, number of sectors used, date the program was put on the disk, the number of program updates along with the date of the latest update, whether the program is BASIC or assembler and the starting location of the program in memory.

The disk software is IBM3740 standard and allows any IBM standard diskette (such as Radio Shack) to be read.

Conclusion

I now have a fantastic PET system. It is unquestionably the most versatile PET around. It wasn't as much trouble as I originally anticipated, and I had fun building it.

The real enjoyment comes from using this disk system. I have about 300 hours of use with the new system and have not had any problems. I have 12 diskettes full of programs or files (approximately 960K of storage) and have never lost a bit. It is a pleasure to load a 16 or 24K program in less than two seconds, or to see 20,830 bytes free after loading the disk software. ■

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Designed for use on TRS-80* 4K LEVEL I 16K LEVEL II

Air Flight Simulation

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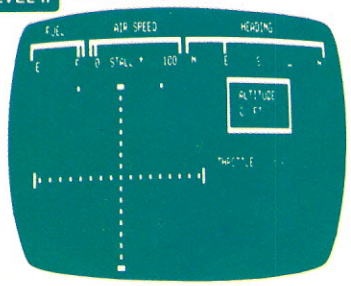

AIR FLIGHT SIMULATION Turn your TRS-80 into an airplane. You can practice takeoffs and landings with the benefit of full instrumentation. This one-player simulation requires a TRS-80 Level I 4K, Level II 16K. **Order No. 0017R $7.95.**

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BASIC AND INTERMEDIATE LUNAR LANDER Bring your lander in under manual control. The BASIC version is for beginners; the Intermediate version is more difficult, with a choice of landing areas and rugged terrain. For one player with a TRS-80 Level I 4K, Level II 16K. **Order No. 0001R $7.95.**

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Level I

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- **Memory** — Two players can pit their memories in this program based on a popular television show.

You'll need a TRS-80 with Level I and 16K. **Order No. 0010R $7.95.**

CAR RACE/RAT TRAP/ANTIAIRCRAFT Enjoy these challenging, fun-filled programs:
- **Car Race** — You and a friend can race on a choice of two tracks.
- **Rat Trap** — Trap the rat in his maze with your two cats. For one player.
- **Antiaircraft** — Aim and shoot down the enemy airplane. Requires Level I 4K TRS-80. **Order No. 0011R $7.95.**

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STATUS OF HOMES/AUTO EXPENSES Two long-awaited programs that have got to save you money at work or in the home:
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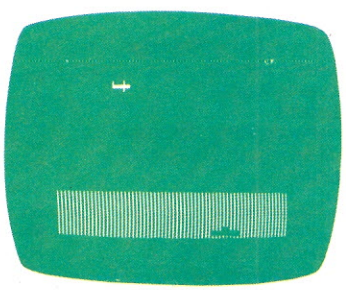

Level I

BUSINESS PACKAGE I Keep the books for a small business with your TRS-80 Level I 4K. The six programs included are:
•**General Information** – The instructions for using the package.
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•**Profit and Loss** – With this program you can quickly get trial balance and profit-and-loss statements.
•**Year-End Balance** – This program will combine all your data from the profit-and-loss statements into a year-end balance sheet.
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BUSINESS PACKAGE III This package can change your TRS-80 into a full working partner for any businessman:
•**Inventory** – Maintain a computer-based inventory for a constant inventory system.
•**Commissions and Percentages** – Let your computer figure out markup and discount calculations, sales tax and more. This is a perfect time-saving package for any small business.
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DOODLES AND DISPLAYS I Here's a mixed bag of programs that's sure to entertain:
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•**Symmetrics** – Turn your TRS-80 into a kaleidoscope.
•**Video Display** – Follow the bouncing cursor as your TRS-80 draws its own pictures.
•**Mathcurves** – Bring those geometry lessons to life as the computer draws six different geometrical curves.
•**Rugpatterns** – A never ending stream of symmetrical patterns that's sure to spark your imagination.
All you'll need is a 16K Level I TRS-80. **Order No. 0030R $7.95.**

SPACE TREK III Let yourself go to the far ends of the solar system – and beyond. This package includes:
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FUN PACKAGE I Why call it "Fun Package"? Judge for yourself! This entertaining package includes:
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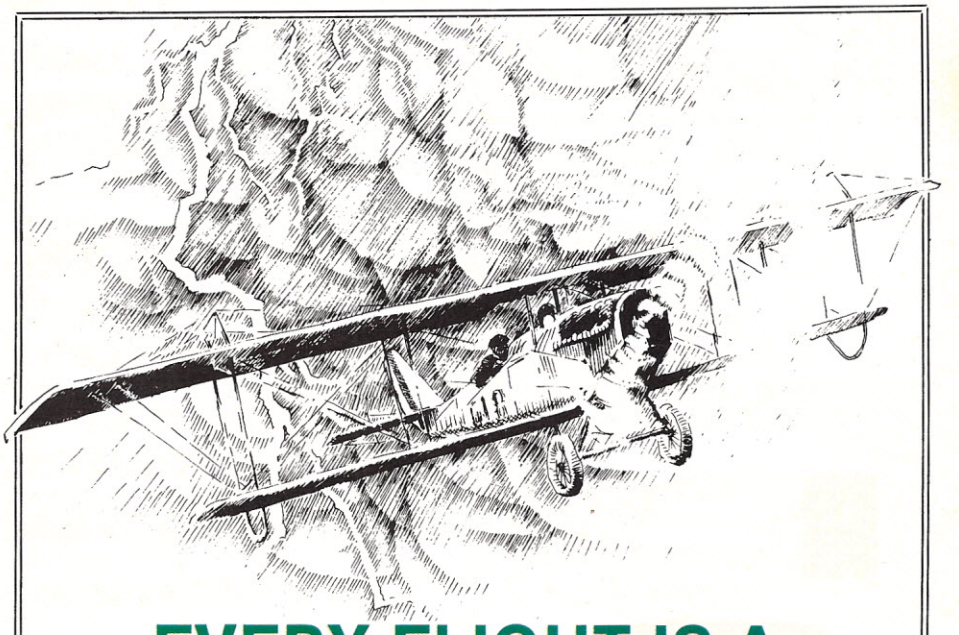
•**Missile Attack** – Use your missiles to protect your city from jet attack.
Requires a Level I 16K TRS-80. **Order No. 0037R $7.95.**

TYPING TEACHER This complete seven-part package takes you all the way from initial familiarization with the keys, through typing words and phrases, to complete mastery of the keyboard. Your computer can even become a bottomless page for typing practice. It only requires a TRS-80 Level I 4K. **Order No. 0099R $7.95.**



EVERY FLIGHT IS A SPECIAL DELIVERY

OK, Ace, you survived everything that von Richthofen and the Flying Circus threw at you. Well, that was four long years ago – and yesterday's medals don't pay the rent. But just a minute, here's an ad:

"Airmail Pilot wanted . . ."

AIRMAIL PILOT

You can almost smell the gasoline as the ground crew fuels your J-4 Jenny biplane to her 26-gallon limit. Precious mail is loaded into the cargo area, tagged for Chicago. The weatherman reports severe icing above 6,000 feet, so you know you have to keep the plane low. It will be a dangerous flight, but you knew that when you took the job. The mail must go through. So, in the tradition of Lindbergh and a hundred unsung heroes, you bravely turn your plane into the wind. The engine roars. Suddenly you're aloft on the first leg of your journey. Dayton's socked in by fog. You change your course for Lucasville. Lightning zigzags the sky. A massive, fast-moving thunderstorm forces you to land in a cornfield. As the weather clears, your plane leaps once more into the sky. But even clear skies can cause problems – violent air currents buffet your fragile wooden aircraft. Your fuel is down to two gallons as Lucasville comes into sight. You make it! Refuel and head for Chicago. But you're not out of trouble yet. There's a wind shear at the Chicago airport. You have to land in a shifting crosswind. Can you make it? AIRMAIL PILOT from INSTANT SOFTWARE. Unlike any other computer simulation you've ever experienced. Challenging. Difficult. But never impossible. An event in a cassette. Crash or fly, it's so realistic, you can almost feel the wind. Requires a Level II 16K. **Order No. 0106R $7.95.**

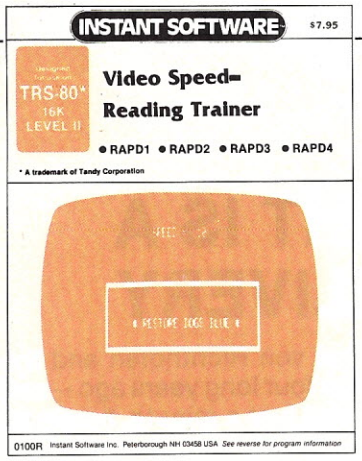
PERSONAL FINANCE I Let your TRS-80 handle all the tedious details the next time you figure your finances:
•**Personal Finance I** – With this program you can control your incoming and outgoing expenses.
•**Checkbook** – Your TRS-80 can balance your checkbook and keep a detailed list of expenses for tax time.
This handy financial control for the home requires only a TRS-80 Level I 4K. **Order No. 0027R $7.95.**

HEXPAWN/SHUTTLE CRAFT DOCKING/SPACE CHASE/SEA BATTLE This four-game package is sure to provide hours of fun for the whole family.
•**Hexpawn** – Turn your TRS-80 into a model of artificial intelligence by playing a simple game.
•**Shuttle Craft Docking** – Land your shuttle craft on the starship – even through varying gravity fields!
•**Space Chase** – Seek out and destroy the enemy delta that's hidden in the star field.
•**Sea Battle** – You must find and destroy the enemy fleet.
This package requires a TRS-80 Level I 16K. **Order No. 0041R $7.95.**

DEMO I This package is just the thing to show your friends what your TRS-80 can do. Included are:
•**Computer Composer** – Compose and play music using only a standard AM radio.
•**Baseball** – Play baseball with your computer while it does the scorekeeping.
•**Horse Race** – Place your bet and cheer your pony to the winner's circle.
•**ESP** – Test your powers of extrasensory perception.
•**Hi-Lo/Tic-tac-toe** – Guess the secret number or get three in a row.
•**Petals Around the Rose** – Can you figure out the secret behind the five dice?
•**Slot Machine** – Turn your computer into a one-armed bandit. These programs require a TRS-80 Level I 4K. **Order No. 0020R $7.95.**

Level II

TRS-80 UTILITY I Ever wonder how some programmers give their programs that professional look? Instant Software has the answer with the TRS-80 Utility I package. Included are:
•**RENUM**—Now you can easily renumber any Level II program to make room for modification or to clean up the listing.
•**DUPLIK**—This program will let you duplicate any BASIC, assembler, or machine-language program, verify the data, and record the program on tape. You can even do Level I programs on a Level II machine. For the TRS-80 Level II 16K. **Order No. 0081R $7.95.**



VIDEO SPEED-READING TRAINER As your eyes move along, reading this sentence, do you see the words like t h i s ? Most people's reading speed is limited simply because they read individual letters or words. Now you can increase your reading speed and comprehension, and soon be reading whole words and phrases, with the Video Speed-Reading Trainer package from Instant Software.

Using the same scientific principle as the tachistoscope, a mechanical device used to flash characters or words on a screen, this three-part program will train your mind to quickly recognize numbers, words, letters, and phrases.

The program will take you step by step through a systematic training procedure. You'll start at whatever level of competency you feel is appropriate, and the computer will automatically advance you as your reading speed and comprehension increase. For the Level II 16K TRS-80 Microcomputer. **Order No. 0100R $7.95.**

DEMO II Now get more fun for the bucks with this amazing package.
•**Tic-Tac-Toe**—Play an old-time favorite with three levels of difficulty.
•**Time Trials**—Try to beat the clock as you race your car through curves, chutes, and chicanes.
•**Maze**—One or two players can search through the maze for the secret square.
•**Hangman**—One or two players can try to guess the secret word.
•**Wheel of Fortune**—Choose your number, place your bet, and see if you can break the bank (for one to eight players).
•**Hurricane**—Now you can track and monitor hurricanes anywhere in the world.
•**Bugsy**—Can you build your Z-80 bug before the computer does?
•**Horse Race**—Pick a sure winner and place your bet (for 1 to 100 players).
All you'll need is a TRS-80 Level II 16K. **Order No. 0049R $7.95.**

RAMROM PATROL/TIE FIGHTER/KLINGON CAPTURE Buck Rogers never had it so good. Engage in extraterrestrial warfare with:
•**Ramrom Patrol**—Destroy the Ramrom ships before they capture you.
•**Tie Fighter**—Destroy the enemy Tie fighters and become a hero of the rebellion.
•**Klingon Capture**—You must capture the Klingon ship intact. It's you and your TRS-80 Level II 16K battling across the galaxy. **Order No. 0028R $7.95.**

DOODLES AND DISPLAYS II Wait until your children get hold of this package:
•**Doodle Pad**—Draw pictures and save them on cassette tapes.
•**Symmetrics**—An electric kaleidoscope that changes from black to white and back again. It's almost hypnotic!
•**Drawing**—Like Doodle Pad, but for the serious artist. Over 40 user commands!
•**Random Pattern Display**—The computer does the drawing, but those with itchy fingers can tamper.
•**Mathcurves**—Bring those geometry lessons to life. Six different geometrical curves on the screen of your TRS-80.
•**Rugpatterns**—Yes, it does design rug patterns; and with a choice of user or computer control, it can do a whole lot more.
For the Level II 16K TRS-80. **Order No. 0042R $7.95.**

DEMO III This is the biggest package that Instant Software has ever released. Just look at what's included:
•**Race 1**—Careen around the race course as you try to beat the clock.
•**Target UFO**—Destroy all the invading UFOs to rack up a big score.
•**Life**—Experiment with this simulation of the life cycle of a colony of bacteria.
•**Phone Number Converter**—Change those hard-to-remember 7-digit phone numbers into easily remembered words.
•**Biorhythm**—You or your friends can see your biorhythm curves whenever you want.
•**Graphics Program**—This program will really show you what your TRS-80's graphics display can do.
•**Race 2**—Our racing game simulation for the more experienced driver includes a choice of five different tracks.
•**Horse Race**—Up to nine players can bet on and enjoy our most entertaining horse race program.
•**Drawing Board**—Draw pictures or messages and store them in memory or on cassette tape with this easy-to-use program.
•**24-Hour Clock**—Transform your computer into an accurate digital clock.
To enjoy this tremendous value, you'll need a TRS-80 Level II 16K. **Order No. 0055R $7.95.**

HOUSEHOLD ACCOUNTANT Let your TRS-80 help you out with many of your daily household calculations. Save time and money with these fine programs:
•**Budget and Expense Analysis**—You can change budgeting into a more pleasant job with this program. With nine sections for income and expenses and the option for one- and three-month review or year totals, you can see where your money is going.
•**Life Insurance Cost Comparison**—Compare the costs of various life insurance policies. Find out the difference in price between term and whole life. This program can store and display up to six different results.
All you need is TRS-80 Level II 16K. **Order No. 0069R $7.95.**

FINANCIAL ASSISTANT Compute the figures for a wide variety of business needs. Included are:
•**Depreciation**—This program lets you figure depreciation on equipment in five different ways.
•**Loan Amortization Schedule**—Merely enter a few essential factors, and your TRS-80 will display a complete breakdown of all costs and schedules of payment for any loan.
•**Financier**—This program performs thirteen common financial calculations. Easily handles calculations on investments, depreciation, and loans.
•**1% Forecasting**—Use this simple program to forecast sales, expenses, or any other historical data series.
All you need is a TRS-80 Level II 16K. **Order No. 0072R $7.95.**

MODEL ROCKET ANALYZER AND PRE-FLIGHT CHECK Let your TRS-80 help you enjoy the fast-growing hobby of model rocketry. The complementary programs included are:
•**Model Rocket Flight History Prediction**—This program will compute the flight characteristics for almost any model rocket. Engine and body tube data included covers Estes, Centuri, Flight Systems, A.V.I. Astroport, C.M.R., and Kopter products.
•**Weather Forecaster**—Before you launch your rocket, get an up-to-the-minute weather forecast. Just enter your location, elevation, average temperatures for January and July, and barometric pressure. You'll be the short-range weather forecaster for your area.
For a successful launch, you'll need TRS-80 Level II 16K. **Order No. 0024R $7.95.**

CARDS This one-player package will let you play cards with your TRS-80—talk about a poker face!
•**Draw and Stud Poker**—These two programs will keep your game sharp.
•**No-Trump Bridge**—Play this popular game with your computer and develop your strategy.
This package's name says it all. Requires a TRS-80 Level II 16K. **Order No. 0063R $7.95.**

PERSONAL BILL PAYING

NOTE: This package can take the headaches and/or penalties out of paying your bills.

In a business office the accounts payable (bills) are usually paid on or immediately before their due date. That way, the payer gets the fullest use of his money without incurring penalties for being behind in paying his debts. Now you can take advantage of this system for your monthly bills, letting your TRS-80 do all the drudgery and record keeping.

This useful package provides a computerized list of all your bills and payments. You can access as many as 22 accounts, all of which can be named—up to 15 characters per name. Each account is listed by number, amount owed, due date, and present activity.

Don't confuse this system with a "checkbook" program. The functions of this package are threefold: (1) to monitor your bills; (2) to order payments most effectively; and (3) to make historical comparisons of individual accounts or specific months.

After you load the program, it displays a menu of 11 activities. They include:
Build and Maintain Files
List All Accounts
List Current Accounts
Make Payment(s) to Account
Enter New Bill to Account
Display Payment History of Individual Account (includes date paid, check number, and 12-month total)
Display Payment History of Selected Month
Delete Account
Delete Prior Month's Payment
Save File on Tape
Input File from Tape

After you have updated the records by entering new bills, paying bills, or changing the accounts, you can save all the information on data tape. This data tape will then be input for the next time you use the package. Maybe it can't make paying bills all fun and games, but it should relieve some of the agony. Level II 16K required. **Order No. 0103R $7.95.**

Level II

SPACE TREK IV Trade or wage war on a planetary scale. This package includes:
•**Stellar Wars** – Engage and destroy Tie fighters in your attack on the Death Star. For one player.
•**Population Simulation** – A two-player game where you control the economy of two neighboring planets.
You decide, guns or butter, with your TRS-80 Level II 16K. **Order No. 0034R $7.95.**

TEACHER Now you can have the benefits of computer-assisted instruction right in your own home. The programs allow you to input any number of questions and answers. Using this data, the computer will prepare several types of tests, quiz students, provide up to three "hints" per question – even offer graphic rewards for younger children, all at the user's discretion. Perfect for parents, teachers, or anyone faced with learning a lot of material in the shortest possible time. Furnished with blank data cassette.
Teacher requires a 16K Level II TRS-80. **Order No. 0065R $9.95.**

TRS-80 UTILITY II Let Instant Software change the drudgery of editing your programs into a quick, easy job. Included in this package are:
•**CFETCH** – Search through any Level II program tape and get the file names for all the programs. You can also merge BASIC programs with consecutive line numbers into one program.
•**CWRITE** – Combine subroutines that work in different memory locations into one program. This works with BASIC or machine-language programs and gives you a general checksum.
This package is just the thing for your TRS-80 Level II 16K. **Order No. 0076R $7.95.**

Santa Paravia and Fiumaccio

Buon giorno, signore!
Welcome to the province of Santa Paravia. As your steward, I hope you will enjoy your reign here. I feel sure that you will find it, shall we say, profitable.

Perhaps I should acquaint you with our little domain. It is not a wealthy area, signore, but riches and glory are possible for one who is aware of political realities. These realities include your serfs. They constantly request more food from your grain reserves, grain that could be sold instead for gold florins. And should your justice become a trifle harsh, they will flee to other lands.

Yet another concern is the weather. If it is good, so is the harvest. But the rats may eat much of our surplus, and we have had years of drought when famine threatened our population.

Certainly, the administration of a growing city-state will require tax revenues. And where better to gather such funds than the local marketplaces and mills? You may find it necessary to increase custom duties as well as tax the incomes of the merchants and nobles. Whatever you do, there will be far-reaching consequences . . . and possibly an elevation of your noble title.

Your standing will surely be enhanced by building a new palace, or perhaps a magnificent *cattedrale*. You will do well to increase your landholdings, if you also equip a few units of soldiers. There is, alas, no small need for soldiery here, for the crafty Baron Peppone may invade you at any time.

To measure your yearly progress, the official mapmaker will draw you a *mappa*. From it you can see how much land you hold, how much of it is under the plow, and how adequate your defenses are. We are unique in that here, the map IS the territory.

I trust that I have been of help, signore. I look forward to the day when I may address you as His Royal Highness, King of Santa Paravia. *Buon fortuna*, or, as you say, "Good luck." For the TRS-80 Level II 16K. **Order No. 0043R $7.95.**

PET**

PERSONAL WEIGHT CONTROL/BIORHYTHMS Let your PET help take care of your personal health and safety:
•**Personal Weight Control** – Your PET will not only calculate your ideal weight, but also offer a detailed diet to help control your caloric intake.
•**Biorhythms** – Find out when your critical days are for physical, emotional, and intellectual cycles.
You'll need only a PET with 8K memory. **Order No. 0005P $7.95.**

CASINO I These two programs are so good, you can use them to check out and debug your own gambling system!
•**Roulette** – Pick your number and place your bet with the computer version of this casino game. For one player.
•**Blackjack** – Try out this version of the popular card game before you go out and risk your money on your own "surefire" system. For one player.
This package requires a PET with 8K. **Order No. 0014P $7.95.**

MORTGAGE WITH PREPAYMENT OPTION/FINANCIER These two programs will more than pay for themselves if you mortgage a home or make investments:
•**Mortgage with Prepayment Option** – Calculate mortgage payment schedules and save money with prepayments.
•**Financier** – Calculate which investment will pay you the most, figure annual depreciation, and compute the cost of borrowing, *easily and quickly*.
All you need to become a financial wizard with an 8K PET. **Order No. 0006P $7.95.**

CASINO II This craps program is so good, it's the next best thing to being in Las Vegas or Atlantic City. It will not only play the game with you, but will also teach you how to play the odds and make the best bets. A one-player game, it requires a PET 8K. **Order No. 0015P $7.95.**

TREK-X Command the Enterprise as you scour the quadrant for enemy warships. This package not only has superb graphics, but also includes programming for optional sound effects. A one-player game for the PET 8K. **Order No. 0032P $7.95.**

CHECKERS/BACCARAT Play two old favorites with your PET.
•**Checkers** – Let your PET be your ever-ready opponent in this computer-based checkers program.
•**Baccarat** – You have both Casino- and Blackjack-style games in this realistic program.
Your PET with 8K will offer challenging play anytime you want. **Order No. 0022P $7.95.**

DOW JONES Up to six players can enjoy this exciting stock market game. You can buy and sell stock in response to changing market conditions. Get a taste of what playing the market is all about. Requires a PET with 8K. **Order No. 0026P $7.95.**

TANGLE/SUPERTRAP These two programs require fast reflexes and a good eye for angles:
•**Tangle** – Make your opponent crash his line into an obstacle.
•**Supertrap** – This program is an advanced version of Tangle with many user control options.
Enjoy these exciting and graphically beautiful programs. For one or two players with an 8K PET. **Order No. 0029P $7.95.**

PET**

MIMIC Test your memory and reflexes with the five different versions of this game. You must match the sequence and location of signals displayed by your PET. This one-player program includes optional sound effects with the PET 8K. **Order No. 0039P $7.95.**

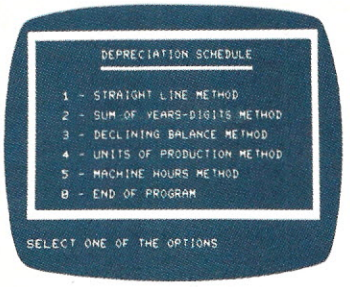
PENNY ARCADE Enjoy this fun-filled package that's as much fun as a real penny arcade – at a fraction of the cost!
- **Poetry** – Compose free verse poetry on your computer.
- **Trap** – Control two moving lines at once and test your coordination.
- **Poker** – Play five-card draw poker and let your PET deal and keep score.
- **Solitaire** – Don't bother to deal, let your PET handle the cards in this "old favorite" card game.
- **Eat-Em-Ups** – Find out how many stars your Gobbler can eat up before the game is over.

These six programs require the PET with 8K. **Order No. 0044P $7.95.**

ARCADE II One challenging memory game and two fast-paced action games make this one package the whole family will enjoy for some time to come. Package includes:
- **UFO** – Catch the elusive UFO before it hits the ground!
- **Hit** – Better than a skeet shoot. The target remains stationary, but you're moving all over the place.
- **Blockade** – A two-player game that combines strategy and fast reflexes.

Requires 8K PET. **Order No. 0045P $7.95.**

BASEBALL MANAGER This pair of programs will let you keep statistics on each of your players. Obtain batting, on-base, and fielding averages at the touch of a finger. Data can be easily stored on cassette tape for later comparison. All you need is a PET with 8K. **Order No. 0062P $14.95.**



ACCOUNTING ASSISTANT This package will help any businessman solve many of those day-to-day financial problems. Included are:
- **Loan Amortization Schedule** – This program will give you a complete breakdown of any loan or investment. All you do is enter the principal amount, interest rate, term of the loan or investment, and the number of payments per year. You see a month-by-month list of the principal, interest, total amount paid, and the remaining balance.
- **Depreciation Schedule** – You can get a depreciation schedule using any one of the following methods: straight line, sum of years-digits, declining balance, units of production, or machine hours. Your computer will display a list of the item's lifespan, the annual depreciation, the accumulated depreciation, and the remaining book value. This package requires the PET 8K. **Order No. 0048P $7.95.**

DIGITAL CLOCK Don't let your PET sit idle when you are not programming – put it to work with these two unique and useful programs:
- **Digital Clock** – Turn you PET into an extremely accurate timepiece that you can use to display local time and time in distant zones, or as a split-time clock for up to nine different sporting events.
- **Moving Sign** – Let the world know what's on your mind. This program turns your PET into a flashing graphic display that will put your message across. **Order No. 0083P $7.95.**

DECORATOR'S ASSISTANT This integrated set of five programs will compute the amount of materials needed to redecorate any room, and their cost. All you do is enter the room dimensions, the number of windows and doors, and the base cost of the materials. These programs can handle wallpaper, paint, panelling, and carpeting, letting you compare the cost of different finishing materials. All you'll need is a PET 8K. **Order No. 0104P $7.95.**

DUNGEON OF DEATH Battle evil demons, cast magic spells, and accumulate great wealth as you search for the Holy Grail. You'll have to descend into the Dungeon of Death and grope through the suffocating darkness. If you survive, glory and treasure are yours. For the PET 8K. **Order No. 0064P $7.95.**

ARCADE I This package combines an exciting outdoor sport with one of America's most popular indoor sports:
- **Kite Fight** – It's a national sport in India. After you and a friend have spent several hours maneuvering your kites across the screen of your PET, you'll know why!
- **Pinball** – By far the finest use of the PET's exceptional graphics capabilities we've ever seen, and a heck of a lot of fun to boot.

Requires an 8K PET. **Order No. 0074P $7.95.**

TURF AND TARGET Whether on the field or in the air, you'll have fun with the Turf and Target package. Included are:
- **Quarterback** – You're the quarterback as you try to get the pigskin over the goal line. You can pass, punt, hand off, and see the result of your play with the PET's superb graphics.
- **Soccer II** – Play the fast-action game of soccer with four playing options. The computer can play itself or a single player; two can play with computer assistance, or two can play without help.
- **Shoot** – You're the hunter as you try to shoot the bird out of the air. The PET will keep score.
- **Target** – Use the numeric keypad to shoot your puck into the home position as fast as you can.

To run and score, all you'll need is a PET with 8K. **Order No. 0097P $7.95.**

Apple***

GOLF Without leaving the comfort of your chair, you can enjoy a computerized 18 holes of golf with a complete choice of clubs and shooting angles. You need never cancel this game because of rain. One or two players can enjoy this game on the Apple with Applesoft II and 20K. **Order No. 0018A $7.95.**

BOWLING/TRILOGY Enjoy two of America's favorite games transformed into programs for your Apple:
- **Bowling** – Up to four players can bowl while the Apple sets up the pins and keeps score. Requires Applesoft II.
- **Trilogy** – This program can be anything from a simple game of tic-tac-toe to an exercise in deductive logic. For one player.

This fun-filled package requires an Apple with 20K. **Order No. 0040A $7.95.**

MATH TUTOR I Parents, teachers, students, now you can turn your Apple computer into a mathematics tutor. Your children or students can begin to enjoy their math lessons with these programs:
- **Hanging** – Perfect your skill with decimal numbers while you try to cheat the hangman.
- **Spellbinder** – Cast spells against a competing magician as you practice working with fractions.
- **Whole Space** – While you exercise your skill at using whole numbers, your ship attacks the enemy planet and destroys alien spacecraft.

All programs have varying levels of difficulty. All you need is Applesoft II with your Apple II 24K. **Order No. 0073A $7.95**

MORTGAGE WITH PREPAYMENT OPTION/FINANCIER (see description for PET version 0006P) This package requires the Apple 16K. **Order No. 0094A $7.95.**

ACCOUNTING ASSISTANT (see the description for the PET version 0048P) This package requires the Apple 16K. **Order No. 0088A $7.95.**

MIMIC (see description for the PET version 0039P) This package requires the Apple 24K. **Order No. 0025A $7.95.**

MATH TUTOR II Your Apple computer can go beyond game playing and become a mathematics tutor for your children. Using the technique of immediate positive reinforcement, you can make math fun with:
- **Car Jump** – Reinforce the concept of calculating area while having fun making your car jump over the ramps.
- **Robot Duel** – Practice figuring volumes of various containers while your robot fights against the computer's mechanical man.
- **Sub Attack** – Take the mystery out of working with percentages as your submarine sneaks into the harbor and destroys the enemy fleet.

All you need is Applesoft II with your Apple II and 20K. **Order No. 0098A $7.95.**

HEATH****

MENTAL GYMNASTICS Pit your mind against the challenge of these ancient games:
- **Reversi** – As you and a friend or the computer place your pieces on the board, you must each try to capture your opponent's pieces. The score can fluctuate wildly, and nobody can tell who'll win until the last move.
- **Wari** – You can play a friend or the computer in this simple yet intriguing game. The two players take turns removing pieces from one cup and placing them in the other cups. As play continues, the number of pieces decreases. The last player who has a piece to move wins the game.

To enjoy these ageless games, you'll need the Heath H-8 with 8K. **Order No. 0087H $7.95.**

DATA TAPES Use these high-quality leaderless data tapes to record business or personal data. Four tapes per package. **Order No. 0067 $7.95.**

*A trademark of Tandy Corporation
**An trademark of Commodore Business Machines, Inc.
***A trademark of Apple Computer, Inc.
****A trademark of the HEATH Company

Ask for Instant Software at a computer store near you.

Alabama
Anderson Computers
3156 University Dr., Huntsville

The Computer Shack
913 Shadyview Lane, Adamsville

Computerland of Huntsville
3020 University Dr., Huntsville

Olensky Bros.
3763 Airport Blvd., Mobile

Arizona
Millets TV & Radio
621 East Broadway, Mesa

Resalem Electronics
16610 Meadow Park Dr., Sun City

California
Amco Elect. Supply
635 E. Arrow Hwy., Azusa

Byte Shop of Fairfield
87 Marina Center St., Suisun City

Byte Shop of Mt. View
1415 West El Camino Real, Mt. View

Byte Shop of Sacramento
6041 Greenback Ln., Citrus Heights

Capital Computer Systems
3396 El Camino Ave., Sacramento

Computer Components of South Bay
15818 Hawthorne Blvd., Lawndale

Computer World
6791 Westminster Ave., Westminster

Computerland
16720 S. Hawthorne, Lawndale

Computerland of San Francisco
117 Fremont St., San Francisco

Computerland of W. LA
6840 La Cienega Blvd., Englewood

Hobby World
19511 Business Ctr. Dr., Unit 6
Borthridge

I.C.E. House Inc.
398 North E. St., San Bernardino

Marfam Co.
6351 Almadin Rd., San Jose

Microsun Computer Center
2989 North Main St., Walnut Creek

Opamp/Technical Books
1033 N. Sycamore Ave., Los Angeles

Radio Shack Dealer
8250 Mira Mesa Blvd., San Diego

Santa Rosa Computer Center
604 7th St., Santa Rosa

Silver Spur Elect. Comm.
13552 Central Ave., Chino

The Computer Store
820 Broadway, Santa Monica

Colorado
Byte Shop
3464 S. Acoma St., Englewood

Computerland of North Denver
8749 Wadsworth Blvd., Arvada

The Computer Store
2300 Welton St., Denver

Connecticut
American Business Computers
Rt. 184 & Rt. 117, Groton

Bridgeport Computers Inc.
3876 Main St., Bridgeport

Computerlab
130 Jefferson, New London

Customized Computer Systems
120 Sherman Ave., New Haven

The Computer Store
43 South Main St., Windsor Locks

D.C.
The Program Store
4200 Wisconsin Ave., N.W.,
Washington, D.C.

Florida
AMF Electronics
11146 N. 30th St., Tampa

Boyd-Ebert Corporation
1328 West 15th St., Panama City

Computer Center
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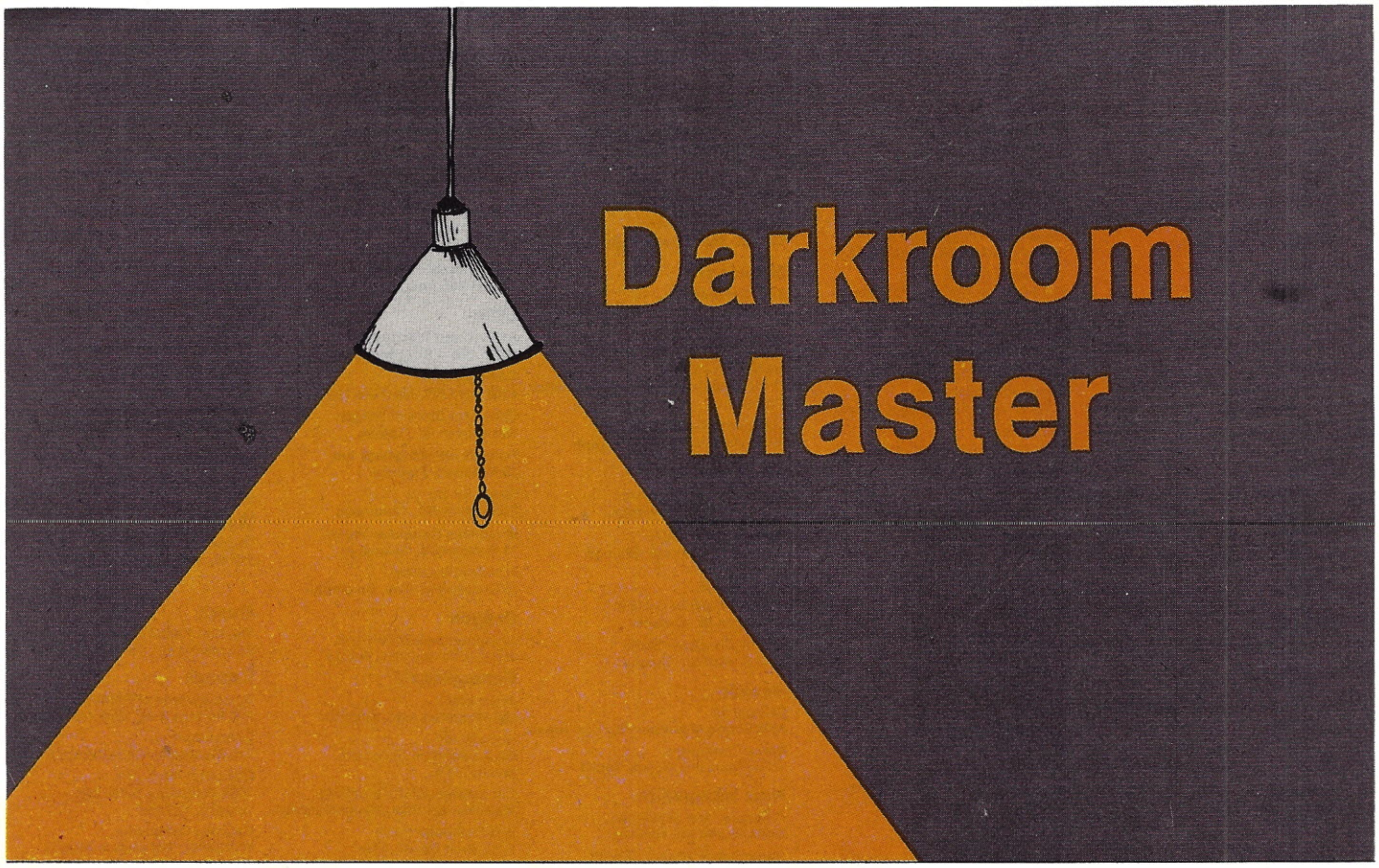


Unleash your PET in the darkroom.

Jeff Knapp
1823 7th Ave.
Charleston WV 25302

Many people who have computers and electronics for hobbies or vocations also enjoy another technical field, photography. This program for the PET allows you to combine the two fields to give you a practical application for the computer and, in addition, bring computer accuracy to the darkroom.

Darkroom Master will let you automate many of the timing functions in your black-and-white or color darkroom. With it you can control your enlarger and safelight for exposure and sequentially time the processing of your film, prints or slides.

The Software

There are four major sections to the software: the control routine, containing a menu of available functions (each function also has its own menu); the exposure control routine for enlarger and safelight operations; the process control routine for film and print developing; and the clock/timer routine, which is called by the exposure and process routines. All the routines make extensive use of the PET BASIC GET command and the PET's real-time clock.

The control routine contained in lines 130–230 GETS the menu choice and sends you to the appropriate section of the program. As in all sections, the GET command is used for menu choices so you do not have to

Darkroom Master.

```
10 REM◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇
20 REM
30 REM                          DARKROOM MASTER
40 REM
50 REM                           BY JEFF KNAPP
60 REM
70 REM
80 REM
90 REM◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇◇
100 POKE59459,255:POKE59471,0:DIMP$(6)
110 P$(1)="SQQQQ":P$(2)="SQQQQQQQ":P$(3)="SQQQQQQQQQQ":P$(4)="SQQQQQQQQQQQQQ"
120 P$(5)="SQQQQQQQQQQQQQQQQ":P$(6)="SQQQQQQQQQQQQQQQQQQQ"
130 REM************ TITLE PAGE
140 PRINT"Ↄ          ______________________"
150 PRINT"          ▚  DARKROOM MASTER   "
160 PRINTP$(2);TAB(4);"PRESS . FOR  EXPOSURE CONTROL"
170 PRINTP$(3);TAB(4);"PRESS - FOR  PROCESS CONTROL"
190 GETC$:IFC$=""THENGOTO190
200 IFC$="."THENGOSUB 250:GOTO 280
210 IFC$="-"THENGOTO 640
230 GOTO140
240 REM******* EXPOSURE CONTROL ROUTINE
250 PRINT"Ↄ";TAB(8);"______________________"
260 PRINT"          ▚  EXPOSURE CONTROL  "
270 RETURN
280 PRINTP$(1);TAB(4);"PRESS  .  TO FOCUS"
290 PRINTP$(2);TAB(4);"PRESS  -  TO SET EXPOSURE TIME"
300 PRINTP$(3);TAB(4);"PRESS  =  TO START OVER"
310 GETA$:IFA$=""THENGOTO 310
320 IFA$="."THENGOTO 360
330 IFA$="-"THENGOTO 460
340 GOTO140
350 REM****** FOCUS ROUTINE
360 GOSUB 250
370 POKE59471,16
380 PRINTP$(1);TAB(4);"                          "
390 PRINTP$(2);TAB(4);"PRESS  -  TO SET EXPOSURE TIME"
400 PRINTP$(3);TAB(4);"PRESS  =  TO START OVER"
410 GETA$:IFA$=""THENGOTO 410
420 POKE59471,0
430 IFA$="-"THENGOTO 460
440 GOTO140
450 REM****** EXPOSURE ROUTINE
```

press the return key to activate the PET.

If you press the "start over" key or any illegal key, the PET will cancel the function and send you back to the control routine. All of the control keys are located at the bottom of the numeric keypad, with the exception of the space key (more about that later), so that it is easy to make entries without hunting all over the keyboard in the dark and possibly pressing the wrong button.

The exposure control routine, lines 240–630, consists of two subroutines for focusing and obtaining the actual exposure. Each has its own menu of options. The focus subroutine only turns on the enlarger; no timing is performed here. But the exposure subroutine, once it inputs your exposure time, calls the clock/timer and turns off the safelight, turns on the enlarger and starts counting until the clock matches your entry. Then it shuts down the enlarger and turns the safelight back on.

You now have the option of exposing another print (if you want to make 100 prints from the same negative), changing your exposure time, refocusing the enlarger or starting over from control and going on to process your print.

The process control routine, lines 640–1090, as written, is set up for processing black-and-white prints. I'll talk later about setting it up for processing films and color media. Upon going to the routine from control, you will be asked to enter times for developing, stop-bath time, fix time and the drain times in between steps. You can change your times once they are entered if you wish.

When you start the timing, each step is printed on the screen along with its own clock in reverse video. At the end of the timing sequence, you are asked if you want to run the same times again for processing the 100 prints you made earlier.

The clock/timer routine, lines 1100–1270, is the heart of the program. It compares your entry against the current time and takes appropriate action on the

```
460 GOSUB 250
470 PRINTP$(1);TAB(21);"          "
480 PRINTP$(1);:PRINTTAB(8);:INPUT"EXPOSURE TIME";ET$
490 PRINTP$(3);TAB(4);"PRESS  0  TO START/REPEAT EXPOSURE"
500 PRINTP$(4);TAB(4);"PRESS  .  TO CHANGE EXPOSURE"
510 PRINTP$(5);TAB(4);"PRESS  -  TO FOCUS"
520 PRINTP$(6);TAB(4);"PRESS  =  TO START OVER"
530 GETA$:IFA$=""THENGOTO 530
540 IFA$="0"GOTO 580
550 IFA$="."GOTO 470
560 IFA$="-"THENPOKE59471,0:GOSUB 250:GOTO 370
570 GOTO140
580 TM$=ET$:P=1:T=21:TI$="000000"
590 POKE59471,16
600 GOSUB 1100
610 POKE59471,0
620 GOTO 490
630 STOP
640 REM****** PROCESS CONTROL ROUTINE
650 DT$="0":DR$="0":ST$="0":FT$="0":WT$="0":POKE59471,0
660 PRINT"                              "
670 PRINT"          PROCESS CONTROL   "
680 PRINTP$(1);TAB(7):INPUT"DEVELOP TIME ";DT$
690 PRINTP$(2);TAB(6):INPUT"STOPBATH TIME ";ST$
700 PRINTP$(3);TAB(11):INPUT"FIX TIME ";FT$
710 PRINTP$(4);TAB(8):INPUT"DRAIN TIMES ";DR$
720 PRINTP$(6);"PRESS  0  TO START TIMING":PRINT
730 PRINT"PRESS  -  TO CHANGE TIMINGS":PRINT
740 PRINT"PRESS  =  TO START OVER"
750 GETA$:IFA$=""THENGOTO 750
760 IFA$="0"THENGOTO 790
770 IFA$="-"THENGOTO 660
780 GOTO140
790 REM****** DEVELOPING ROUTINE
800 PRINT"                              "
810 PRINT"          PROCESS CONTROL   "
820 PRINTP$(1);TAB(4);"DEVELOPING TIME ":PRINTP$(2);TAB(9);"DRAIN TIME "
830 PRINTP$(3);TAB(6);"STOPBATH TIME ":PRINTP$(4);TAB(9);"DRAIN TIME "
840 PRINTP$(5);TAB(11);"FIX TIME "
850 TM$=DT$:P=1:T=20:TI$="000000"
860 GOSUB 1100
870 POKE59471,4:FORX=1TO1000:NEXT
880 POKE59471,0
890 TM$=DR$:P=2:T=20:TI$="000000"
900 GOSUB 1100
910 POKE59471,4:FORX=1TO1000:NEXT
920 POKE59471,0
930 TM$=ST$:P=3:T=20:TI$="000000"
940 GOSUB 1100
950 POKE59471,4:FORX=1TO1000:NEXT
960 POKE59471,0
970 TM$=DR$:P=4:T=20:TI$="000000"
980 GOSUB 1100
990 POKE59471,4:FORX=1TO1000:NEXT
1000 POKE59471,0
1010 TM$=FT$:P=5:T=20:TI$="000000"
1020 GOSUB 1100
1030 POKE59471,4:FORX=1TO1000:NEXT
1040 POKE59471,0
1050 PRINT:PRINT:PRINT:PRINT"PRESS  0  TO REPEAT":PRINT
1060 PRINT"PRESS  =  TO START OVER"
1070 GETA$:IFA$=""THEN  1070
1080 IFA$="0"THENGOTO 790
1090 GOTO140
1100 REM****** CLOCK/TIMER ROUTINE
1110 MIN$=LEFT$(TM$,1):SEC$=RIGHT$(TM$,2)
1120 PRINTP$(P);TAB(T);"                "
1130 PRINTP$(P);TAB(T);" ";MID$(TI$,3,2);":";RIGHT$(TI$,2);" "
1140 GETA$:IFA$=""THENGOTO 1160
1150 GOSUB 1230
1160 IFRIGHT$(TI$,2)=SEC$THENGOTO 1180
1170 GOTO 1130
1180 IFRIGHT$(MID$(TI$,3,2),1)=MIN$THENGOTO 1200
1190 GOTO 1130
1200 PRINTP$(P);TAB(T);"          "
1210 PRINTP$(P);TAB(T);" ";MID$(TI$,3,2);":";RIGHT$(TI$,2);"  "
1220 RETURN
1230 H$=TI$:IFA$=" "THENPRINTP$(P);TAB(28);" HOLD":GOTO 1250
1240 GOTO140
1250 GETA$:IFA$=""THENGOTO 1250
1260 IFA$=" "THENPRINTP$(P);TAB(28);"       ":TI$=H$:RETURN
1270 GOTO 660
1280 END
```

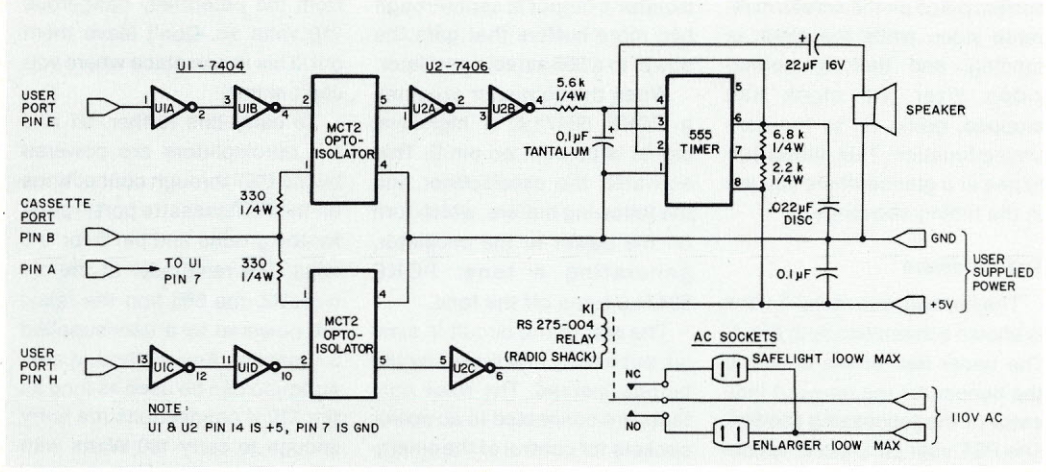


Fig. 1. Darkroom Master circuit diagram.

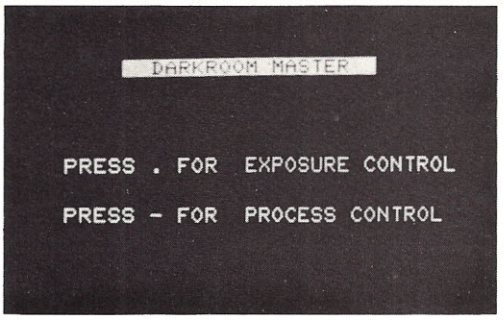
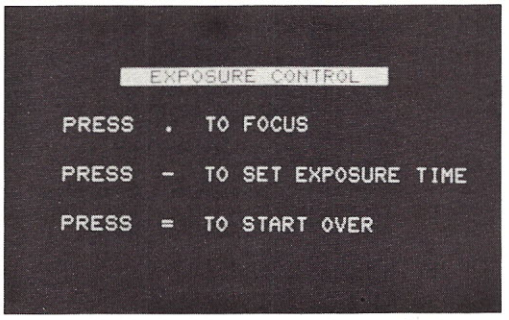


Photo 1.



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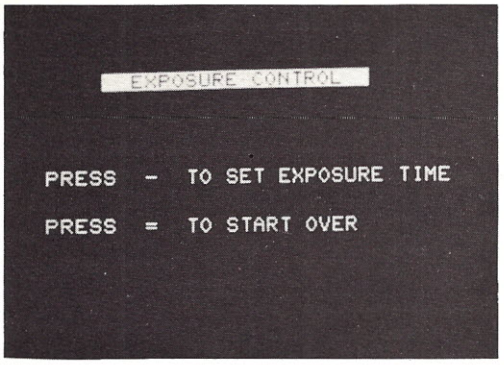

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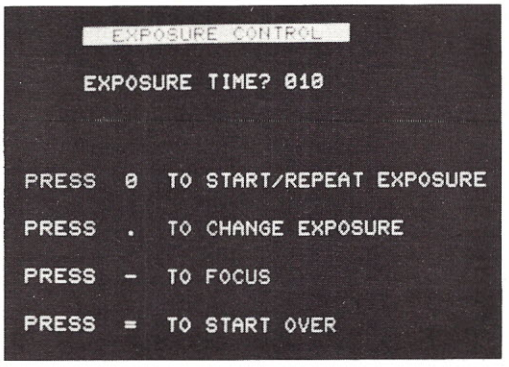

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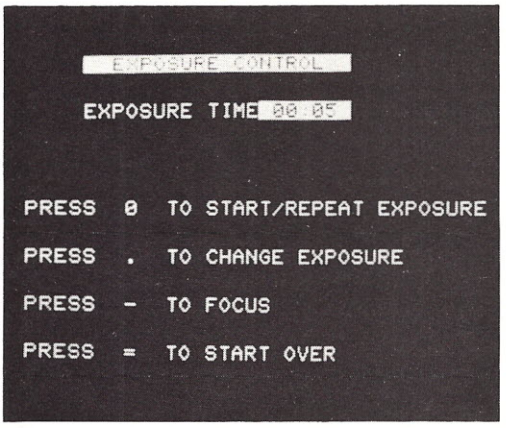

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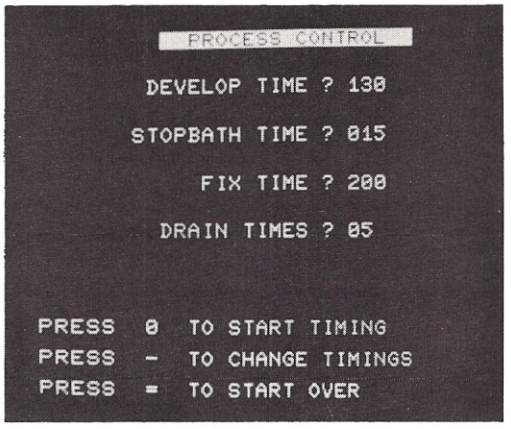

Photo 6.

result. It prints the clock at the correct place on the screen in reverse video while the clock is running, and then in normal video after the clock has stopped, going on to the next timing function. This allows you to see at a glance where you are in the timing sequence.

The Hardware

The hardware to make it work is shown schematically in Fig. 1. The upper half of the circuit is the beeper for the time-out indicator of the processing section. The PET user port, pin E, is connected through two buffers to an optoisolator. The optoisolator's output is sent through two more buffers that gate the power to a 555 astable oscillator.

When the computer executes a POKE 59471,4, a high-level signal is present on pin E. This activates the optoisolator and the following buffers, which turn on the power to the oscillator, generating a tone. POKE 59471,0 turns off the tone.

The rest of the circuit is similar, but a relay is powered by the buffers instead. The relay contacts are connected to ac power sockets for control of the enlarger and safelight. The optoisolators are there to protect the PET from the potentially dangerous 110 volts ac. Don't leave them out. This is one place where you can't skimp.

To carry this further, U1 and the optoisolators are powered by the PET through connections on the PET cassette port—pin A for the ground and pin B for +5 volts. The remainder of the circuit (U2, the 555 and the relay) are powered by a user-supplied 5 V supply. Any method of construction can be used as long as the 110 V connections are hefty enough to carry 100 Watts with no problem. Use twisted pairs to carry the signals from the PET to your enlarger/safelight control box.

Making It Work

When the hardware is constructed and connected, plug the enlarger and safelight into the appropriate outlets and load the program. As you probably know, you must use a safelight in the darkroom, that is, a lamp with a special filter that emits light that your photo materials are *not* sensitive to. This enables you to see what you are doing without ruining the light-sensitive materials.

But where do you find an affordable 5½ × 7½ inch safelight filter for your PET? Go to your local graphic arts or printer's supply shop and purchase a sheet of Amberlith or Rubylith. These are materials manufactured by Ulano, Inc., that allow your printer to mask off portions of the artwork he is photographing to prevent the camera from "seeing" them. They work by blocking the light waves that the film is sensitive to and passing the ones the film is insensitive to.

We can put this to work in our darkroom by covering the PET screen with Rubylith if we are using orthochromatic materials (such as litho film) and by using Amberlith if we are using panchromatic materials such as enlarging papers. These products come in sheets and rolls and are intended to be stripped from the clear backing sheet for use; however, just cut out a section large enough to cover the PET screen and hold it in place with masking tape along the edges.

To keep light from leaking out, turn the brightness all the way down and keep the PET at least four feet away from any light-sensitive materials. You may have to use a double thickness of Rubylith or Amberlith. Of course, you cannot use any safelight with panchromatic sheet film or with color materials, as they are sensitive to almost all visible light wavelengths. So set up your exposure and then cover the PET with a dark cloth before bringing out those materials.

To expose a print, enter ex-

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posure control by pressing the decimal key (Photo 1). You can now focus by again pressing the decimal key (Photo 2). When you have focused, press the minus-sign key (Photo 3). Type in the exposure time (Photo 4). If it is less than one minute, type a leading zero. For example, for a five-second exposure, type in "05"; for a ten-second exposure, type in "010."

For an exposure of one minute or more, type in the number without a leading zero and without a colon. The computer adds the colon for you, i.e., type in "130" for one minute and thirty seconds. You must press return when entering your times for exposure and processing; all other entries are under GET command control and do not require a return.

You now have another menu to choose from. You can start the exposure, change your exposure, recheck your focus or escape back to control.

Start your exposure (Photo 5). The running clock will show in reverse video, properly formatted, at the point on the screen where you entered the exposure time. Remember that I promised you I would explain about the space bar? Here's where it comes into use.

Suppose the print you are making needs a certain area "burned in," that is, given more exposure than the rest of the print. Just press the space bar and the word "hold" will appear next to the clock. This halts the timing, freezes the clock and leaves the enlarger on, allowing you to burn in the chosen area. When you are finished burning in, press the space bar again. The "hold" will disappear and the clock will pick up from where it left off.

When the clock has finished its count, it reverts to normal video, the enlarger turns off and the safelight turns on. Your menu is still on the screen for choosing the next function. To process the print, press the "equal" sign to get back to control and the "minus" sign to go to process control.

To process the print (Photo 6), enter the times for developing, stop bath, fixing and drain. A timer is not included for washing the print because it would tie up the computer for as much as two hours, and washing a print does not require to-the-second accuracy. You can use a wall clock or your wristwatch to time the wash step (don't use an LCD wristwatch with a tritium backlight; it will fog most photo materials).

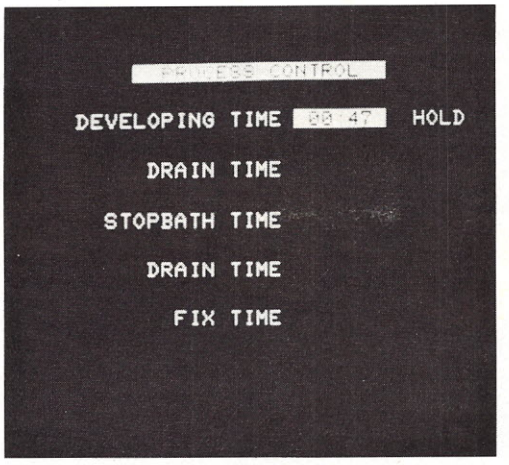


Photo 7.

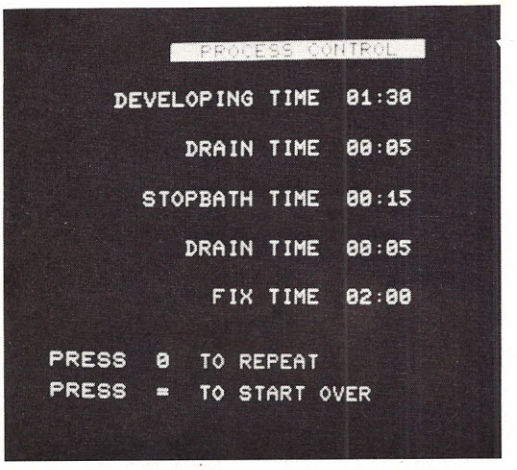


Photo 8.

When entering times, the leading zero rule applies. If you do not wish a drain time between steps, just enter "00" when asked for that time.

As with the exposure control, the clock appears in reverse video (Photo 7), formatted, and reverts to normal video at the end of the count. You can use the hold control here also, as you may want to use hot developer or ferricyanide bleach on the print.

And in both exposure and process controls, you can repeat the timing sequence without resetting the clock (Photo 8). This is helpful if you have to batch-process some prints, such as the 100 prints from one negative I mentioned earlier. You could first expose and then process all of them.

Modifications

If you are more into color prints than black and white, it's just as easy to control the process. You will have to change the process step labels, lines 680–840. And while you are in there, add the POKE commands to turn your motorized agitator on and off with the processing steps! The same principles apply with any process (such as films or litho materials); you may have to add or delete some steps and change the labels.

And to make the work easier, add an external numeric keypad for remote entry of exposure and processing times while the PET is safely away from the enlarger and the sink. Get any 16 button keypad with SPST switches and wire it as shown in Table 1. I have not tried to make a keypad remote yet, but according to what I have read this should work well.

To make the program even more useful, add routines to keep track of the number of prints processed in a gallon of developer, for converting exposure times when using variable-contrast filters and to add an A/D converter for a densitometer to let your computer calculate the exposure times.

Conclusion

There are a lot of things you can do with the hardware and the program when not running Darkroom Master. You can switch two ac devices and use the clock routine in real-time control applications. I'll soon be moving to a new house and look forward to putting my computer to work in a practical application. The program as written runs in 3.8K of PET memory.

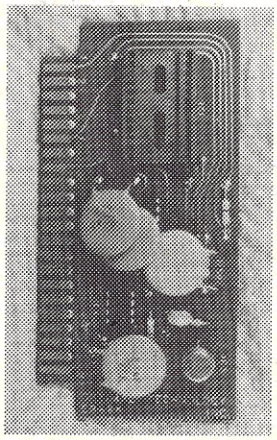
I'll be happy to answer any questions you may have or to hear about how you have used Darkroom Master; just be sure to include return postage if you want a reply.

I want to thank my wife, Millie, for typing the manuscript, and Emory Wright for the use of his PET printer. ■

From Pet Keyboard ConnectorPin	To One Side Of Switch On Keypad	The Other Side Of The Switch To The Pet Key-Board Connector Pin
G	DECIMAL POINT	10
G	0	9
G	1	7
G	2	8
H	3	7
G	4	5
G	5	6
H	6	5
G	7	3
G	8	4
H	9	3
H	9	3
H	MINUS	9
H	EQUALS	10
C	SPACE	9
F	ENTER	5

Table 1.

EPROM PROGRAMMERS



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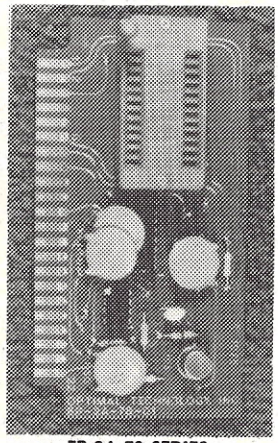

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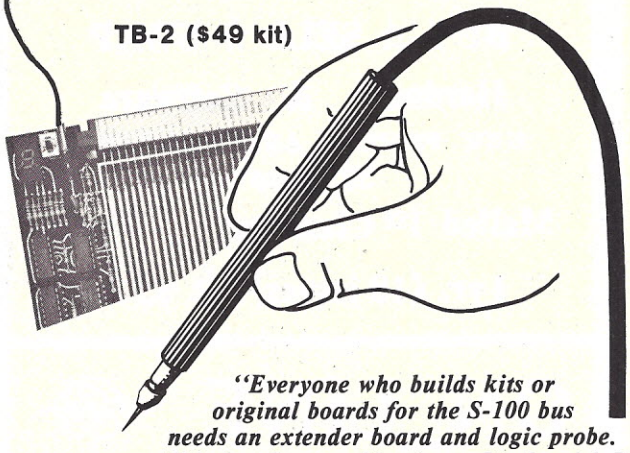

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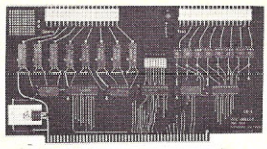

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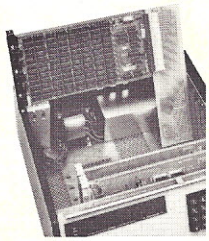

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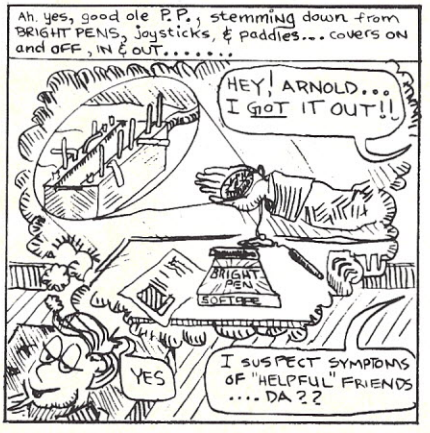
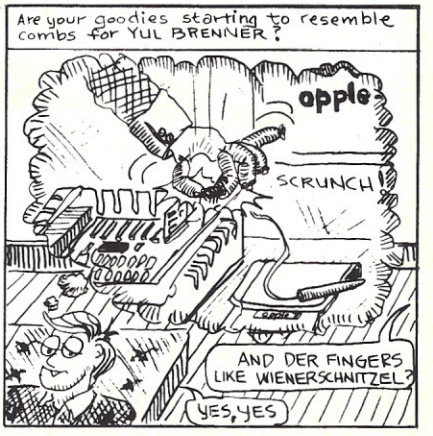
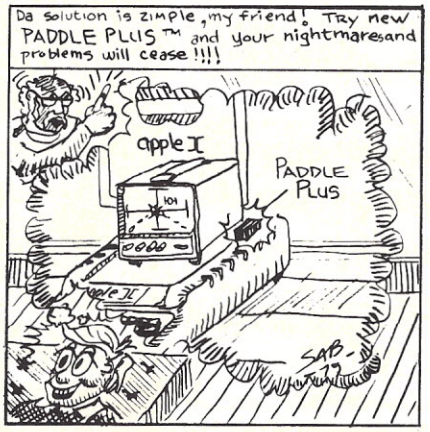
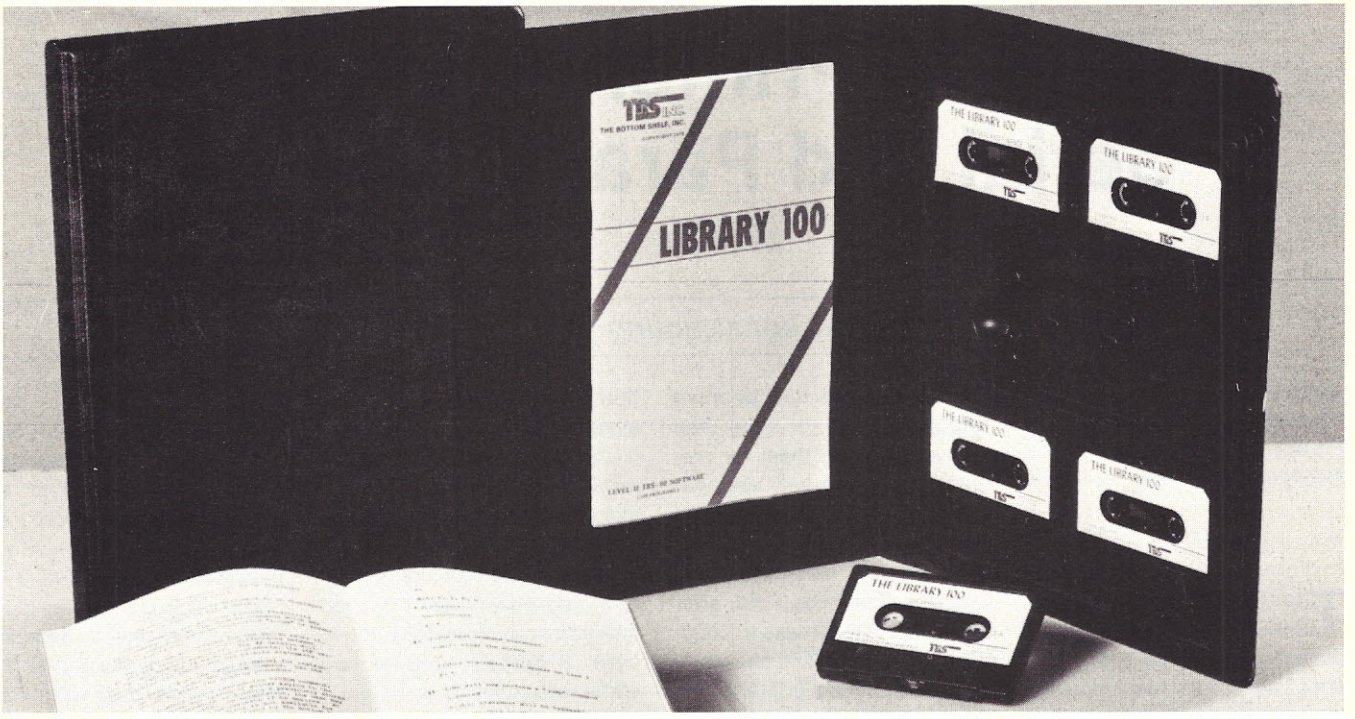






LIBRARY 100



The **LIBRARY 100** from **TBS** is without doubt the greatest software bargain ever. Released in November 1978, it has sold thousands in 44 countries. Written for the TRS-80, **LIBRARY 100** contains 100 programs on five tapes. Most of the programs can be run on a 4K, Level II computer. Designed to be a basic computer library, it provides a series of programs over a broad range of topics. All programs but one are written in BASIC and can easily be modified to suit your own purposes.

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The programs are spread over five general categories; Finance, Education, Graphics, Home and Games. As an added bonus, the **LIBRARY 100** contains Tiny PILOT, a condensed version of the high level language primarily used in education. It is perfect for teachers, parents, students and sales trainees. Using only six commands, even a child could be programming in minutes. The other programs are as follows:

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EDUCATION: Multiplication & Division, Addition, Subtraction, Fraction & Decimal, States & Capitals, States and Order of Entry, States and Date of Entry, States and Abbreviations, Inventors and Inventions, World Capitals & Countries, Urban Areas and Population, Authors & Books, Presidents and Order, States and Largest City, Base Numbers.

GRAPHICS: Front Cover, Wierd, Rat Race, Random Ad, Fireside, Left-Right Ad, Blocks, Herring, Launch, Blinker, Snoopy, Snow, Step Ad, Step Ad Two, Graphic Words, War Games.

HOME: Bartender, Nutrition, Conversion, Perpetual Calendar, Base Conversion, Calculator, Vacation Check-off List, Telecode, Message Board, Night Check-off List, Expense Account, Babysitter, Drunkometer, Remember, Christmas List, Mileage.

GAMES: Jumble, Search, Memory Quiz Letters, Sting Ray, Russian Roulette, Wheel of Fortune, Towers, Decision, Memory Quiz Numbers, Doomsday, Star Trek,™ Sketch, Flipper, Life, Fifteen, Speedy, Count, Road Race, Stars, Odd One, Spy Ship, Horse Race, Scissors, Craps, Star Blazer, Tiger Shark, Unjumble, Mind Reader, Roach Race, Jumble 2, Gypsy.

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The TRS-80 is a great personal computer. I don't think that it can be beat in its price class. I've had mine for several months and I really enjoy using it. It is a simple machine, yet it is capable of quite sophisticated results.

I have owned one or more microcomputers for more than two years. I use them for program development and for manuscript preparation and printing. Since both of these tasks require hard-copy facilities, the first thing I did, after buying my TRS-80, was to determine the easiest (and cheapest) way to interface a printer.

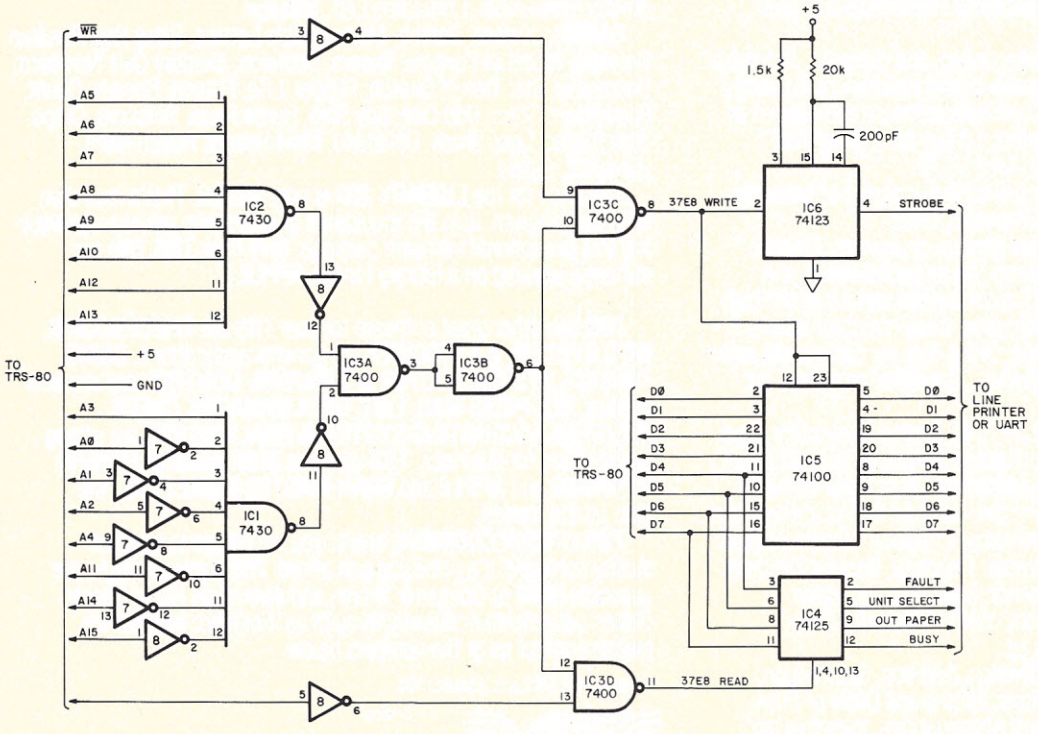
You might ask, "Is a printer really necessary to write programs?" Yes, because it is very difficult to get a good idea of the flow of your program without being able to see it all in one piece. It is also easier to find errors and make corrections. The screen is just not large enough to hold all of the information required.

The designers of the TRS-80 obviously understood the need for hard-copy capability since Level II BASIC contains the statements LPRINT and LLIST, both of which output to the printer port instead of to the screen. The Expansion Interface includes a parallel port to feed a printer.

However, therein lies a dilemma. In order to implement hard copy on the TRS-80 as envisioned by Radio Shack, it is necessary to purchase the Expansion Interface and a line printer. This is an outlay of from 1300 to 1600 dollars, depending where you buy the printer. What about those of us who already have a printer?

I have been using the Teletype Model 43 KSR for almost a year, and I like it. It prints either 10 or 30 cps, is very quiet, has an RS-232 serial interface and has been 100 percent reliable. In addition, it prints lowercase; the Centronics 779 printer does not. This is a definite plus! Why couldn't I use it for hard copy instead of the parallel line printer that Radio Shack intended?

The Expansion Interface also provides facilities for disk drives, more memory and a second cassette recorder. I don't plan to add any of these to my unit, so I decided to design an interface to fit directly between the expansion port on the back of the TRS-80 keyboard unit and the Model 43.



IC	+5	GND
7400	14	7
7404	14	7
7430	14	7
74100	24	7
74123	16	8
74125	14	7

Fig. 1. Schematic drawing of the parallel interface for the TRS-80 expansion port. This will drive a Centronics 779 or similar line printer directly. Many IC substitutions are possible. IC6 could be a 74121, IC3 a 7402; IC5 could be replaced with two 74175s, and the 74125 with an 8T97 or 74367. Most of these changes would require some circuit changes.

My design was successful, as you will see, and the total cost for a serial RS-232 interface was less than $50. If you would like to plug a parallel line printer, such as the Centronics 779, directly into the keyboard expansion port, I'll show you how to do that for less than $5!

The Interface

First let's look at some of the requirements that our interface must meet. I was unable to obtain any information from Radio Shack on this subject, so what follows was learned by my studying the Level II print driver routine and the Expansion Interface schematic.

The printer port is addressed as a memory location instead of as an I/O port. This is called "memory-mapped I/O." The memory location used is 37E8 hex (14312 decimal), which is configured as both an input and an output port.

The print driver routine first reads the input port to see if the printer is ready to receive the next character. If it is, the character is sent to the output port, and then input port status is read continually until the printer is ready for the next character. We can't just dump text to the printer at microprocessor speed because the printer is not able to handle characters that fast.

While it is reading the printer input port the processor is also checking to see that the printer is not out of paper or hasn't some other fault. If you attempt to LPRINT or LLIST to the printer when it has a problem or is out of paper, nothing will happen. In this case it is up to you to determine what the fault is.

In order to implement a printer interface that will work with the TRS-80, you must satisfy the following requirements:

1. Decode memory address 37E8 hex.
2. Determine whether the processor desires to read or to write.
3. Gate status information onto the data bus for a READ.
4. Latch ASCII character from data bus for a WRITE.
5. Provide a WRITE strobe to UART (serial) or printer (parallel).

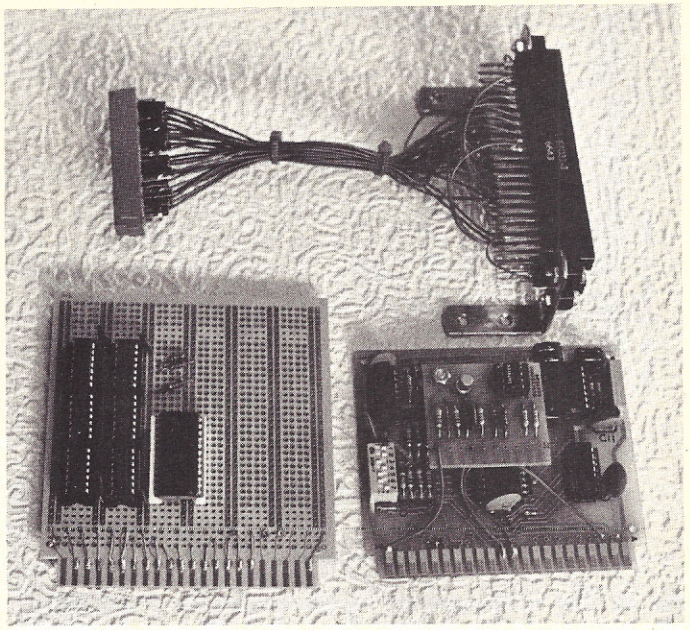
Fig. 1 shows the basic interface. This will drive a parallel printer, such as the Centronics 779, directly, and it should cost less than $5, not including the cost of the two connectors required, to build. It can also be used to drive a UART if you intend to use a printer that has a serial RS-232 interface. I'll get to that in a moment.

First let's look at Fig. 1 and see how it satisfies the interface requirements listed above. ICs 1 and 2 are SN7430 8-input NAND gates. They are used to decode the desired address—in this case, 37E8H. I won't go into the conversion of numbers from hex format to binary format, so you'll have to take my word that 37E8H is equal to 0011011111101000B. From left to right, as shown in Table 1, these 16 binary digits equate to the microprocessor address lines A15 to A0.

Since some of the address lines will be high and some will be low when the desired address (37E8H) appears on the address bus, we use inverters to give each line the correct sense. This means inverting A15, A14, A11, A4, A2, A1 and A0. Note that these correspond to the zeros in Table 1. When all 16 inputs to the 7430s are high (binary 1), the output of IC3b at pin 6 (address decode) will go high. This happens when, and only when, the address 37E8H is on the address bus.

We can determine whether the processor wants to read or write by monitoring the RD and WR leads from the keyboard expansion port. These are active low signals. This means that the processor will take RD low when it wants to read and WR low when it wants to write.

By NANDing "address decode" from IC3b, pin 6, with RD we can generate a "READ strobe" at pin 11 of IC3d. NANDing "address decode" with WR will give us a "WRITE strobe" at pin 8 of IC3c. These two strobes correspond to the 37E8 READ and 37E8 WRITE leads found on the TRS-80 Expansion Interface schematic.



The complete TRS-80 to RS-232 interface. The card on the left is the address decoder and parallel port. On the right is the Electronic Systems UART and Baud Rate Generator board with their TTL to RS-232 converter mounted on top of it. Shown to the rear is the interconnection assembly. The connector on the left plugs into the expansion bus on the back of the TRS-80 keyboard unit, and the two interface cards plug into the connectors on the right. The transmit and ground leads to the printer connect to two pins on the top right-hand connector.

When 37E8 READ goes active (low), the Tri-state buffer (IC4) will gate status information onto the data bus for the processor to read. This includes: "printer busy," "out of paper," "unit select" and "fault." The first two are active low and the last two are active high.

When 37E8 WRITE goes active (low), the octal latch (IC5) latches (stores) the ASCII character that the processor has put on the data bus. This is necessary because the character will only be on the data bus for a few microseconds or so—not long enough for the printer to utilize it. The latch will hold this character until the next one is sent.

Finally, the one shot (IC6) will provide a strobe to the printer telling it that the next character is ready to be printed. IC6 lengthens the 37E8 WRITE pulse, and it isn't necessary if you are going to use a UART. Then the output of IC3c, pin 8 can go directly to the UART.

At this point, if you are going to use the Centronics 779 or an equivalent line printer, you can jump down to the section on construction. However, if you are going the RS-232 route as I did, read on.

Serial RS-232

A serial port handles data (8-bit ASCII characters) one bit

Address bus --->	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
37E8 hex --->	0	0	1	1	0	1	1	1	1	1	1	0	1	0	0	0

Table 1. The relationship between the address bus and a binary 16-bit address. Since the NAND gates (ICs 1 and 2) of Fig. 1 require a high level (binary 1), address lines that are low (binary 0) are inverted before being used.

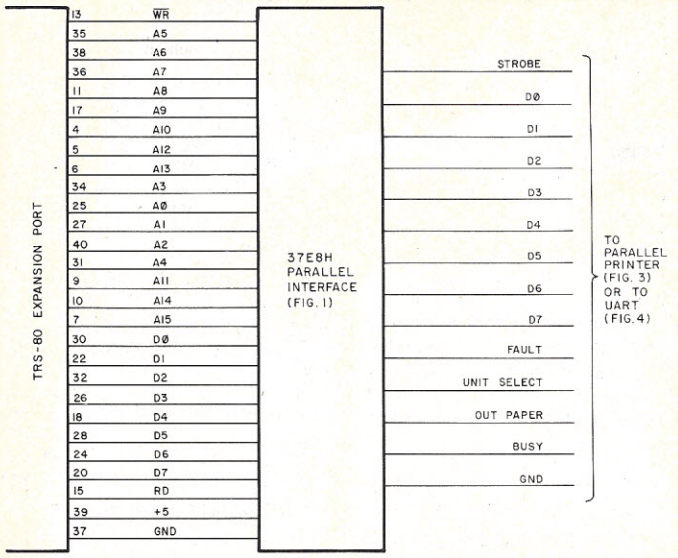


Fig. 2a. The interconnection wiring between the TRS-80 expansion port and the parallel interface of Fig. 1. The leads on the right side go to the parallel printer of Fig. 3 or to the UART of Fig. 4a.

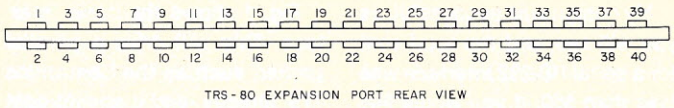


Fig. 2b. Rear view of the TRS-80 expansion port from the keyboard unit.

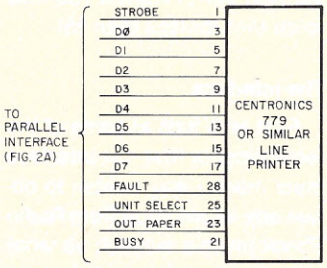


Fig. 3. Connections to the Centronics 779 or similar line printer. The pin numbers shown are for the plug that mates to the connector on the back of the printer.

at a time as opposed to a parallel port, which passes all eight bits at once. Loosely defined, the RS-232 standard says that a high (or binary 1) should be +12 volts and that a low (or binary 0) should be −12 volts. Up to this point our signals have all been TTL levels in which a high is represented by +5 volts and a low by ground.

In order to implement a serial RS-232 port we must take the eight bits presented to us on the data bus in parallel and send them to the printer one bit at a time. This includes providing the proper timing for the particular printer involved. We must also change the TTL levels of +5 volts (binary 1) and 0 volts (binary 0) to the RS-232 levels of +12 volts and −12 volts.

The first two parts of this task are easily taken care of by an IC called a universal asynchronous receiver/transmitter, or UART. There are many different versions of the UART available from the IC manufacturers; the one I used was the AY-5-1013A. The UART is a full-duplex device and, as its name implies, it will receive as well as transmit. In this application we will only be using the transmitter.

Construction

You can build the circuit of Fig. 1 in any way that is convenient. Perfboard or Vectorbord can be used, but I prefer to build all of my circuits on standard 44-contact prototype boards. The Hobby Board from OK Machine and Tool is the one I use.

The +5 volts required by Fig. 1 are available from the keyboard expansion port, but I don't know how much current this will supply. If the fuse blows or the power supply gets too hot, then you will have to provide a separate source of +5 volts. Using the "LS" versions of the 7400 series ICs involved will cut down on the current requirements.

Fig. 2a shows the interconnections between the TRS-80 keyboard expansion port and the parallel interface (Fig. 1). Fig. 2b is an explanatory drawing of the manner in which the contacts on the expansion port are counted. Fig. 3 contains the connections between the parallel interface and the Centronics 779 or similar line printer.

Two connectors will be required. The one that plugs into the keyboard expansion port is identified in my TRS-80 manual as AMP part number 88103-1. Unfortunately, my local Radio Shack store does not stock them. Two different versions are available from Applied Invention, RD2, RT21, Hillsdale NY 12529. One is the solder-tail type; the other comes with 18 inches of ribbon cable attached.

You will also need a connector to match the one on your printer. This will depend on the type of printer.

For those of you who want to use a printer with an RS-232 interface, such as the Teletype Models 33 or 43, the circuitry becomes a little more complicated, but it is still well worth the trouble if it saves you the cost of a new printer.

Rather than build my own UART board I chose to use the UART and Baud Rate Generator board available from Electronic Systems, PO Box 21638, San Jose CA 95151, (408) 226-4064. Write or call for a copy of their catalog, which contains many useful computer-related circuit kits and etched boards.

You will find this UART board described in my article "Parallel Port to RS-232," *Kilobaud Microcomputing*, April 1979, p. 62. You can save quite a bit of money by purchasing the bare board if you already have a UART on hand.

I chose to combine the UART board, which is constructed on a 44-contact card, with a TTL to RS-232 converter kit also available from Electronic Systems. This mating and the modifications required are described in the above article. I advise anyone who is going to tackle this project to read it. The parallel-to-serial and TTL-to-RS-232 conversion circuits can be built from scratch, but it is much easier and quicker when you have access to a PC board with the circuit already etched on it.

Fig. 4a shows the interconnections between the parallel interface, the UART board and the printer serial port. In this case, Fig. 4b should be added to Fig. 2a to make the interface believe that it is connected to the 779 printer. Put this on the same board that Fig. 1 is built on.

Note that in addition to +5 volts, we are also calling for +12 volt and −12 volt supplies. This is to power the UART and to provide the RS-232 levels. Do not

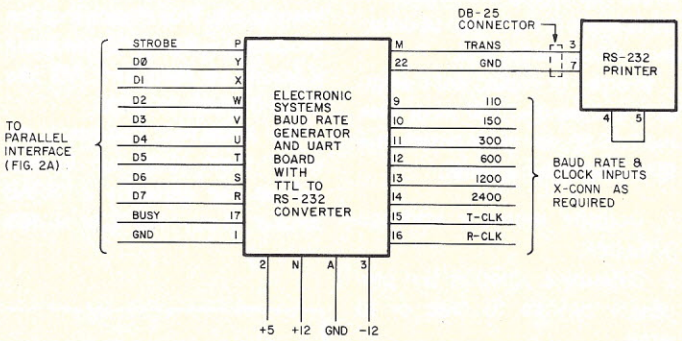


Fig. 4a. Connections in and out of the combined UART, baud rate generator and TTL-to-RS-232 converter. See the reference in the text for more information on this combination. The desired baud rate should be connected to the transmit clock (T-CLK). The strap shown between 4 and 5 on the RS-232 printer plug is to satisfy an internal requirement.

take the +5 from the keyboard to power Fig. 4a. Current requirements are low, and a simple supply will suffice. It must, of course, be regulated.

As mentioned, I built Fig. 1 on a 44-contact Hobby Board; the UART circuitry is constructed on a similar board. Then I mounted two 44-contact edge connectors above each other on a chassis with corner brackets as shown in Fig. 5. These connectors are readily available and come in solder-tail and wire-wrap types. I prefer the wire-wrap type since I am continually changing things.

The cables to the TRS-80 and the printer exit to the rear. Since there is no need to get at the cards once everything is working OK, a cover could be built to improve the appearance of the unit. If a large enough chassis were used, the power supply could be built inside of it.

I'm using a minicomputer power supply that I picked up at an electronics surplus store. They also had some surplus card cages for the 44-contact connectors that would have made an ideal mounting assembly. I'm sorry that I didn't pick them up, but I'll be watching for some for my next project.

After everything is wired together the options must be determined. Note in Fig. 4a the contacts identified as baud rate and clocks. The baud rate required for your printer must be connected to the Transmit Clock. My Model 43 operates at 300 baud; therefore, contact 11 (300 baud) is connected to contact 15 (Transmit Clock). See Fig. 4c for a bottom view of the 44-contact edge connector that the Baud Rate Generator and UART board is plugged into. The baud rate clocks should be adjusted to the correct frequency as explained in the above referenced article.

There is also a multiple DIP (double in-line package) switch on the UART board that must be set. Table 2 gives the options available. My requirements were: S1—ON (input strobe negative), S2—not used, S3—OFF (even parity), S4—ON and S5—OFF (seven bits per character), S6—OFF (two stop bits) and S7—ON (parity). The only settings that you might have to change relate to parity. If in doubt, leave S7 off and ignore S3.

Switch	Purpose	Condition		
S1	Input strobe polarity	ON = NEG	OFF = POS	
S2	Output strobe polarity	ON = POS	OFF = NEG	
S3	Parity	ON = ODD	OFF = EVEN	
S4&S5	Bits per Character	S4	S5	BITS
		ON	ON	5
		OFF	ON	6
		ON	OFF	7
		OFF	OFF	8
S6	Stop bits	ON = 1	OFF = 2	
S7	Parity	ON = YES	OFF = NO	

Table 2. Options available on the Electronic Systems Baud Rate Generator and UART board. These are actually features of the AY-5-1013A and similar UARTs.

Implementation

With the parallel interface installed between the keyboard and a Centronics 779 or equivalent, all that is required for hard copy is to substitute LPRINT and LLIST statements for PRINT and LIST as necessary. Unfortunately, at the last minute a snag that apparently was going to scuttle my intention to use the Model 43 appeared.

For some reason the writers of Level II BASIC apparently decided not to output a line feed after each carriage return. A line feed is not required with printers, such as the Selectric, that automatically provide one each time a carriage return is received. I don't have access to a Centronics 779, but I have to assume that it incorporates that feature. However, neither the Model 33 nor 43 does, and it is awfully hard to read a program listing that is all printed on one line.

I thought I was done for until a little study revealed that the address of the print driver routine is stored in RAM and not in ROM. All that should be required is to poke an address into this storage location pointing to a new print driver residing in high memory. This may sound like extra work since the print driver routine would have to be loaded every time the TRS-80 was turned on, but it still beats buying another printer.

There are many different ways of loading the new print driver routine. If you are running T-BUG, you can create a "SYSTEM" program on tape and load it each time you use the TRS-80. There are also other assembly-language monitors available, such as the ESP-1 from Small System Software.

I've written an assembly-language monitor in Level II BASIC that is described in "Monitor," *Kilobaud Microcomputing*, June, 1979, p. 26. You can also write a straight BASIC program to poke the necessary information into memory.

Program A is the listing of the new print driver routine that I have been referring to. It will pass each character to the printer port whenever it is called, and it will add a line feed (0AH) each time that it detects a carriage return (0DH).

The print driver starting address is stored at locations 4026H and 4027H. These locations normally contain 058DH, the address of the Level II print driver in ROM. 4026H and 4027H must be changed to point to the address of the new print driver, 7FE0H.

Program B does the same thing that Program A does, except that an assembly-language monitor is not needed. Each time Program B is run it will change 4026H and 4027H and load the print driver into memory starting at 7FE0H.

Now let's look at the software steps necessary to make everything operational. When you turn the TRS-80 on it asks you, "MEMORY SIZE?" You type 32734 to reserve some high memory for the new print driver.

If you are not going to use an assembly-language monitor, you can skip this paragraph. Load your monitor, enter Program A at 7FE0H, E0H at 4026H,

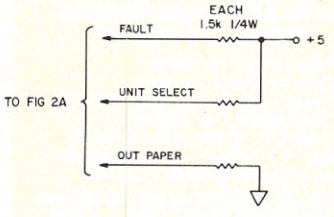


Fig. 4b. This little mod is used with Fig. 1 when it is connected to a UART. This will properly condition fault lines that normally go to the line printer.

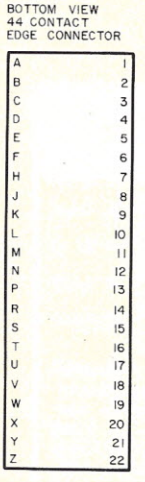


Fig. 4c. A bottom view of the UART and baud rate generator connector showing how the contacts are identified. You can assign your own contacts on the interface board.

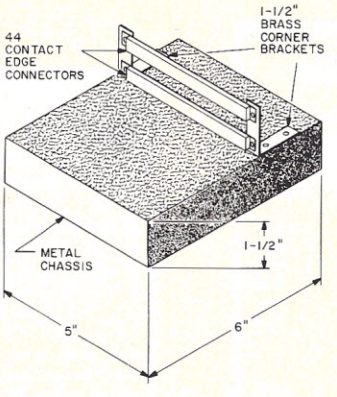


Fig. 5. One way of mounting the two circuit boards described in this article. Many other arrangements could be worked out. However you do it, keep the leads from the TRS-80 to the interface and from the interface to the printer as short as possible.

```
ADDRESS   MACHINE     LABEL   MNEMONICS      COMMENTS
          CODE
7FE0      3A E8 37    LOOP    LDA PORT       READ STATUS
7FE3      E6 F0               ANI F0H        MASK LOWER HALF
7FE5      FE 30               CPI 30H        IS PRINTER READY?
7FE7      C2 E0 7F            JNZ LOOP       IF NOT, TRY AGAIN
7FEA      79                  MOV A,C        GET CHARACTER
7FEB      FE 0D               CPI CR         IS IT CARRIAGE RETURN?
7FED      C2 F8 7F            JNZ OUT        IF NOT, GOTO OUT
7FF0      32 E8 37            STA PORT       WRITE CHARACTER
7FF3      0E 0A               MVIC LF        LOAD LINEFEED
7FF5      C3 E0 7F            JMP LOOP       CHECK STATUS
7FF8      32 E8 37    OUT     STA PORT       WRITE CHARACTER
7FFB      C9                  RET            RETURN TO BASIC
```

Program A. The print driver routine that is required if your printer does not insert a line feed after each carriage return it receives. This was written on an 8080 assembler, but the TRS-80 doesn't know any better and will run it anyhow. Although this is for the Level II 16K TRS-80, it will work in the 4K machine by changing all of the 7Fs to 4F. Your response to MEMORY SIZE? would then be 20447.

```
10 REM *PRINT DRIVER ROUTINE*
20 REM *BY ROD HALLEN  TOMBSTONE, AZ*
30 REM *16 JANUARY 1979*
40 POKE 16422,224
50 POKE 16423,127
60 FOR I=1 TO 28
70 READ D
80 POKE 32735+I,D
90 NEXT I
100 DATA 58,232,55,230,240,254,48
110 DATA 194,224,127,121,254,13,194
120 DATA 248,127,50,232,55,14,10
130 DATA 195,224,127,50,232,55,201
140 END
```

Program B. This is Program A rewritten in Level II BASIC. Running it will POKE the start address of the new print driver routine at 4026H and 4027H. Note that the address is stored least significant byte first, i.e., E0H in 4026H. It will then POKE the new print driver starting at 7FE0H. Write this one for 4K by changing 127 to 79 each time it appears in the data statements.

7FH at 4027H, and make a tape for later use.

Program B can be loaded from the keyboard like any other BASIC program, and a "CSAVE" will give you a tape copy.

From now on, all you have to do is load the print driver from tape. If it is the Program B version, you will also have to run it; then it can be deleted with a NEW.

This is another of those cases where it sounds more complicated than it is. Try it and see.

Conclusion

Once I discovered that I was going to have to write my own print driver routine I was tempted to abandon the memory-mapped I/O port and go to straight I/O addressing. This would have reduced the number of ICs in the interface by two or three since I'd only have to decode eight bits instead of 16, and I'd pick an I/O port, such as FDH, that would require minimum address line inversion. Since the interface was already built by then, I decided to leave it alone.

I could also have reduced the number of inverters required by using NOR gates instead of NAND gates for IC3. Also, I could have reduced the +5 requirements by using the 74LS series of ICs. However, to expedite the project, I used the chips I had on hand.

A while ago I interfaced an RS-232-EBCD-coded Selectric to my Sol using this same circuit. I no longer have the Selectric, but I'll bet it wouldn't take much to get it working with the TRS-80.

There is no good substitute for hard copy. I hope the information that I have provided above and in the referenced articles will help you interface a printer to your TRS-80. I'll be glad to answer any questions that are accompanied by a self-addressed stamped envelope. ■

The OSI Challenger 1P MF

Just starting microcomputing? You might try this minifloppy system from Ohio Scientific.

Charles Curley
6061 Lime Ave.
Long Beach CA 90805

The OSI Challenger 1P MF (minifloppy) is an excellent starter system for the beginner home computerist who wishes to get into computing with a maximum of ease but a minimum of expense. If the beginner wishes to expand, he can do so with no problems, but the unit is almost stand-alone as it comes. With one exception, the documentation is excellent, and OSI promises to provide user support for years to come.

Ohio Scientific has been advertising their new C1P MF as the first minifloppy system available for under $1K. Strictly speaking, it is. However, a user will need one or two more items in order to use the system: a TV or monitor and perhaps a TV signal generator.

Due to FCC regulations, a computer manufacturer cannot sell a computer that you can just hook up to your TV, so you have three options: (1) buy a monitor and take the intermediate frequency signal the computer produces and feed it to the monitor; (2) modify your present TV for direct video signal injection (i.e., allow it to also function as a monitor); or (3) buy a TV signal generator to feed the computer's signal into your TV.

In any case, the additional expense will run $20 to $130, depending on which way you go and how much quality you insist on. Still, $1100 is impressive for a minifloppy system.

This is definitely a bare-bones system. Peripherals such as an extensive monitor or color graphics are available as extras only. Considering that the proper customer for the Challenger 1P MF is the newcomer to personal computing, this is not a serious objection. Indeed, you can say that it gives the customer something to look forward to.

This machine is clearly aimed at the beginner who wishes to enter personal computing as painlessly as possible. One could spend much less and buy, say, a KIM. Then you could program in assembly language and hand assemble. Or you could spend an amount comparable to the cost of the C1P MF and buy, say, a PET or a TRS-80. In either case, you would still have to use a cassette for bulk storage, with all the hassles that cassettes imply. A minifloppy drive for the PET or TRS-80 would cost $400 or so, an amount the C1P MF owner could put to other uses.

The C1P MF disk-based computer.

Software

In the bare-bones configuration of the C1P MF, the speed and convenience of the minifloppy disk is the main selling point of the system. The user is provided with a small DOS (disk operating system), the Pico DOS. With no memory expansion beyond the initial 12K RAM, the DOS supports two commands: LOAD X and SAVE X, where X is a digit from one to eight. X defines the storage area on the disk from which data is to be loaded or to which it is to be saved.

The addition of 8K more RAM (OSI list, $138) will allow the use of a much more extensive DOS, Ohio Scientific's OS-65D ($50). This DOS supports a much more extensive set of commands. It allows a file structure for programs. This means that a program can input from or write to a file on disk (e.g., a word processor that would rapidly fill up the available RAM can put its output directly onto disk, where it has a lot more room). The enlarged DOS supports six character names for files, rename capabilities and other features.

The BASIC provided in the bare-bones machine is a Microsoft BASIC occupying 8K of ROM. It is 6½ digits in precision, has string functions, trig functions and full scientific notation, among other features. A number of these features are not found on other beginner's BASICs.

The OS-65D DOS supports a 9½ digit BASIC, which is slower than the ROM BASIC but more precise. This precision is suitable for scientific or business applications. This BASIC occupies 12K of RAM, and the user can software-select which BASIC he wishes to use.

As I mentioned, OSI does not have color graphics for the Challenger series. They expect to provide it as an option in the future. The screen resolution is 256 by 256, which divides into 32 lines of 32 characters each. However, the mechanics of televisions may restrict you to 24 lines by 24 characters.

OSI software is geared to this limitation. The characters themselves are eight dots by eight and include all standard ASCII characters. In addition, there are 160 special characters in ROM: gaming elements, graphic elements and others. Any character can be invoked simply by

POKEing the appropriate memory location with its number. A full catalog of the symbols available with their numbers in decimal (for use with BASIC) and hex (for use with machine code) is included with the manual.

The keyboard is totally software controlled. This gives the ambitious programmer much greater flexibility than with a hardware-controlled keyboard. For one thing, it allows the detection of up to eight simultaneous key depressions. One application of this facility might be to program eight keys into two pseudo-joystick arrangements. The auto-repeat feature of the keyboard software is also useful.

This flexibility also allows multiple applications of the keys, which are not immediately apparent. For example, in BASIC mode, a /SHIFT/ o deletes the last character, and a /SHIFT/ p deletes the current line. These two functions greatly facilitate program and text editing.

One function bodes well for the use of the C1P MF as a terminal. The /SHIFT/ o function appears on the display by inserting a / (ASCII 2F), rather than removing the offending character. With the cost of modems coming down, private phone systems and micro-oriented data networks in the offing, many home computers will be used as terminals as well as stand-alone systems. OSI designed the C1P MF to be used as a terminal as well as a stand-alone, so adding this function will be easy.

Documentation

Contrary to OSI's reputation for bad or nonexistent documentation, I found the C1P MF documentation to be quite good. I quickly found whatever information I needed to use the machine. The beginning BASIC programmer will need a good book on the system, but this is true of any starter system. Anyone who wishes to program in assembly language or machine language is similarly encouraged to have a good book on 6502 programming handy. The manual does have a number of BASIC demonstrator programs that the user can enter and modify for the learning experience he will gain.

A source listing of the BASIC was noticeably missing from the documentation. This is a result of having Microsoft write the BASIC; a standard part of their contract is that no source listing can be released by the manufacturer. Fortunately for the typical user of the C1P MF, this is not a serious objection.

Options

A fully expanded system could include: 32K RAM, dual minifloppies, a cassette recorder, a printer, a modem and a number of other peripheral boards. The user can buy ready-made peripherals or build his own.

The C1P, the cassette version of the C1P MF.

The user who has little or no interest in programming for himself can purchase ready-to-run software from OSI. Several game disks, personal or business disks and education disks are already available from OSI, with each disk containing up to eight programs. As far as I know, there are no other sources for software, but this should change as more units are sold.

The user who wants to buy a cassette machine now and expand up to a disk system later should consider the C1P, the cassette version of the C1P MF. With only 4K of RAM and *sans* cassette recorder, the unit is otherwise identical to the C1P MF and lists for $349. A minifloppy ($450), 8K of RAM ($138) and some diskettes ($8 each) complete the conversion.

About the only problem I had reviewing the Challenger was finding one! I called various dealers in my area (southern California) as well as Ohio Scientific. I finally found one at Anaheim Computer and Video, who were most cooperative. If you are in southern California and wish to see a machine, give them a call (714/995-0224). Otherwise, call or write Ohio Scientific (1333 S. Chillicothe Rd, Aurora OH 44202; 216/562-3101) or OSI West (15461 Chemical Lane, Huntington Beach CA 92649; 714/891-2457). ■

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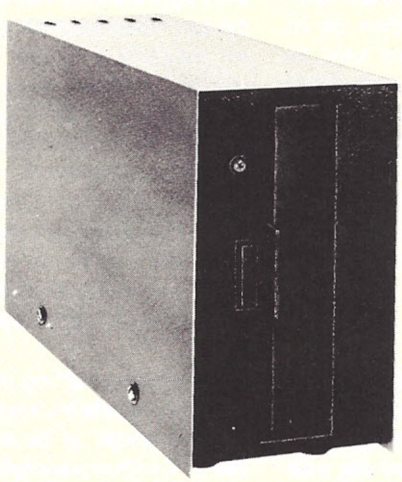

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A Heath H8 Disassembler

This article picks up where "CONOPS" (July 1979, page 108) left off.

Disassemble your Heath H8 software and learn from the professionals. If you want to educate yourself in the art of programming, this is one of the most productive exercises you can perform.

I have anticipated this need of H8 owners and present this disassembler, which will run on your versatile Heath machine without using up a lot of that expensive memory. You are already familiar with "CONOPS," the H8 console-oriented operating system (July 1979 *Microcomputing*, p. 108). This disassembler uses many CONOPS subroutines and has been cunningly designed to occupy a block of adjacent memory, which makes permanent attachment easy.

What Does It Do?

A disassembler looks at a program stored in memory and helpfully translates each instruction byte from binary code into the mnemonic language used by assemblers. Just tell "Sammy" where to begin and he will print the instruction address, the hexadecimal instruction and the corresponding mnemonic.

Sammy will not give you labels or remarks and can deal only with instruction codes. Data bytes (ASCII characters, for example) are not recognized. Sammy assumes everything is an instruction and will print garbage when data is encountered. On a straight op code diet, he will make no errors and, fortunately, will recover in a couple of bytes when meeting instruction bytes again after being brought down by data.

CONOPS, including the disassembler and string finder, is available from the author for $5 (one per customer). It comes on cassette in H8 memory image format, assembled to start at any requested address between 2700 and B700.

How to Use It

Load the program into your H8, byte by byte. It will take some time, but the listing is in hexadecimal, so you can use the efficient CONOPS program loader referenced earlier. To run the disassembler, hit G for GO and enter 67DF, the starting address. You will then see the following display:

```
BEGIN ADDR?
```

Now, enter the address of the first byte of the program you wish to disassemble. Take care to start it on the first byte of an instruction code. If you enter 6C00, the start of CONOPS, you will be rewarded with a display as follows:

```
6C00 C3 C1 6E JMP
```

Push any key other than A or S to decode the next instruction:

```
6C03 7E MOV A,M
```

If you want to save yourself the trouble of pushing a key to advance the disassembler, you can press the A key, which will change the mode to automatic. The program will then do its own stepping and can be stopped only by a reset applied from the H8 front panel keypad. The automatic mode is useful if you have a printer. In the one-step mode, entering an S will stop the program and exit to ***, the operating system ready prompt.

How Does It Work?

Look at an 8080 op code table, like the one on the large plastic card that comes with your H8, and you will see that the mnemonics have a curious variety. The character count of the main word ranges from 2 to 4. Appended characters number 0 to 4. Many bytes of any disassembler are used by the mnemonic lookup tables. For each of the 244 op codes, the program must contain the following data: the mnemonic, coded in ASCII; formatting information; and instruction byte count.

A single lookup table holding all this data would use about 1400 bytes of memory. Such a table would contain many repetitive words. For example, MOV appears in 63 instructions; the appended letter B appears in 45. Avoiding as much of this wasteful duplication as possible was one of the main considerations in the design of this disassembler program.

Studying the op code table reveals some useful facts.

1. Bits 6-7 of the op code identify certain subgroups. In split-octal, these two bits are 0, 1, 2 or 3.

2. All codes starting with 1 or 2 are single-byte instructions.

3. All codes in octal group 100-177, with one exception, are MOV instructions.

4. Codes in octal 200-277 are combinations of eight 3-character, basic mnemonic words plus eight single-character operands.

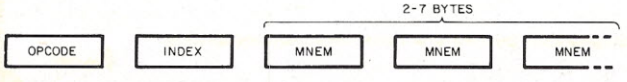


Fig. 1.

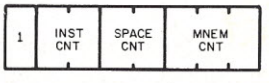
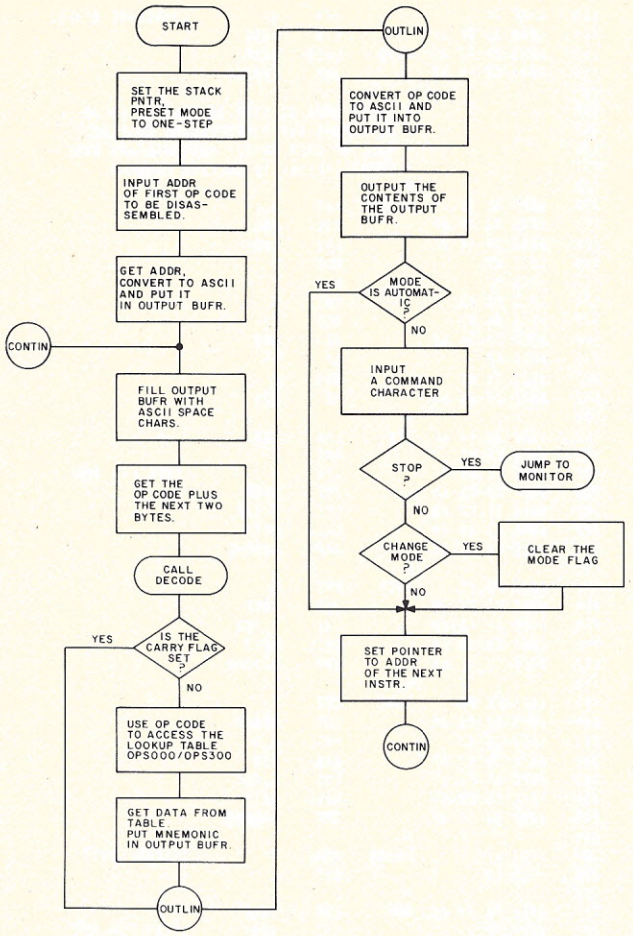


Fig. 2.



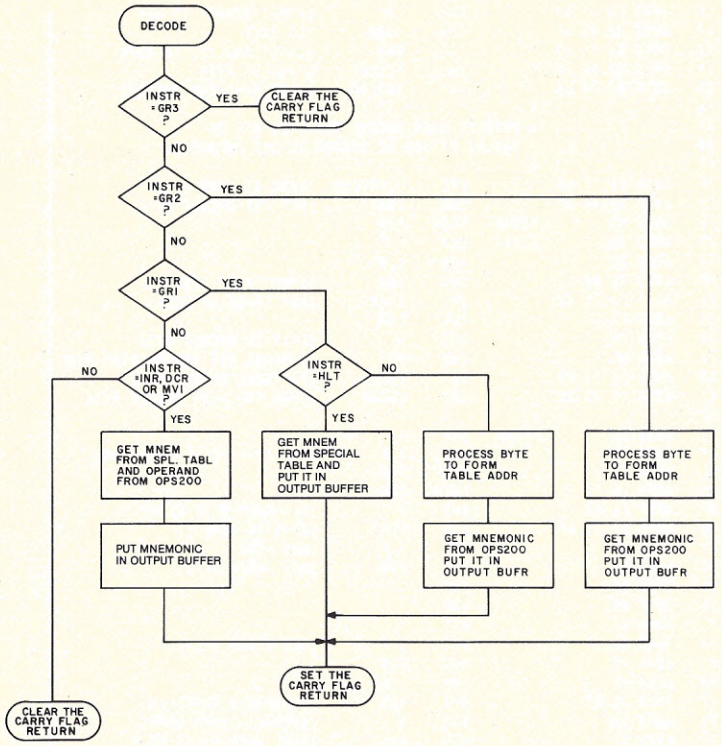


Fig. 3. Program flowchart.

In this program, the lookup tables have a total byte count of 606. The large, general table, OPS000/OPS300, has the arrangement shown in Fig. 1.

The index byte has a most significant bit of 1, which makes it identifiable as a non-mnemonic. The table is scanned starting at the high-end address —the location called STSCAN in the Disassembler program listing. When the index byte is encountered, the next byte down is an op code byte, which is compared with the instruction byte held in Reg A. When a match is found, the table pointer is advanced to decode the index byte and then to read the mnemonic and place it in the output buffer LIN. The table contains no spaces. Space information is in the index byte.

The index byte is encoded as shown in Fig. 2. MNEM CNT is the total number of characters in the mnemonic, excluding spaces. It may be 2 to 7. SPACE CNT is the number of spaces between the main mnemonic word and any appended operand. It may be zero to 3. INST CNT is the number of bytes in the instruction. It may be 1 to 3.

Two other tables are used. OPS200 serves the octal group 200-277 and is used, in a limited way, by groups 000 and 100. The remaining table supplies mnemonics for the instructions INR, DCR, MVI, MOV and HLT. OPS200 is accessed by the subroutines GET1, GET3 and ADDONE.

The flowchart in Fig. 3 gives an overall view of the program structure, which is simple and easy to follow. DECODE is a subroutine, with a return at the end of each branch. It is called by the main program and comes back with the status of the carry flag controlling the next step.

I have found the disassembler useful not only in the analysis of unknown programs, but also in checking for loading errors. You can add another code to your CONOPS jump table to select the disassembler. I use S for "Sammy." ■

Disassembler program.

```
                        *  DISASSEMBLER FOR HEATH H8 COMPUTER
                        *
                        *  FOR USE WITH "CONOPS", THE H8 CONSOLE
                        *  ORIENTED OPERATING SYSTEM. SEE KILOBAUD.
                        *
                        *    BY CHESNEY E. TWOMBLY
                        *        15 STORER ST.,
                        *      KENNEBUNK ME 04043
                        *
                        *          2/11/79
                        *
                        *
                                 OPT    MEM,NUM
                        *
6F3E                             ORG    $6F3E
                        *
            6FB0        STACK    EQU    $6FB0
            6DB4        MS1      EQU    $6DB4
            6C03        PDATA    EQU    $6C03
            6C4C        IN4H     EQU    $6C4C
            6C11        CRLF     EQU    $6C11
            6C1D        INCHR    EQU    $6C1D
            6EDB        MONIT    EQU    $6EDB
            6C55        HEXL     EQU    $6C55
            6C59        HEXR     EQU    $6C59
                        *
6F3E                    MCNT     DS     1
6F3F                    MODE     DS     1
6F40                    ADDM     DS     2
6F42                    ADDR     DS     2
6F44                    INST     DS     1
6F45                    OPER     DS     2
6F47                    NBR      DS     1
6F48                    LIN      DS     27H
                        *
67DF                             ORG    $67DF
                        *
                        *  MAIN PROGRAM
                        *
67DF 31 B0 6F           ENTER    LXI    SP,STACK
67E2 21 B4 6D                    LXI    H,MS1
67E5 CD 03 6C                    CALL   PDATA
67E8 3E FF                       MVI    A,$FF
67EA 32 3F 6F                    STA    MODE       ;PRESET STEP MODE
67ED CD 4C 6C                    CALL   IN4H       ;GET START ADDR
67F0 EB                          XCHG              ;H,L < D,E
67F1 22 42 6F                    SHLD   ADDR       ;SAVE IT
67F4 E5                 CONTIN   PUSH   H          ;STACK < ADDR
67F5 CD 8E 69                    CALL   SPACES
67F8 E1                          POP    H          ;H,L < ADDR
67F9 7E                          MOV    A,M        ;GET OPR #1
67FA 32 44 6F                    STA    INST       ;SAVE IT
67FD 23                          INX    H
67FE 7E                          MOV    A,M        ;GET OPR #2
67FF 32 45 6F                    STA    OPER       ;SAVE
6802 23                          INX    H
6803 7E                          MOV    A,M        ;GET OPR #3
6804 32 46 6F                    STA    OPER+1     ;SAVE
6807 21 48 6F                    LXI    H,LIN      ;PNTR TO START OF BUFR
680A 3A 43 6F                    LDA    ADDR+1     ;GET ADDR HI BYTE
```

```
                        CALL    CBH         ;CONVT BINARY TO HEX
                        LDA     ADDR        ;LO BYTE
                        CALL    CBH         ;CONVT AND PUT IN BUFR
                        CALL    DECODE      ;PROCESS BYTE
                        JC      OUTLIN      ;HAVE COMPLETE MNEMONIC
                *
                * ENTERED WHEN OPCODE REQUIRES USE OF
                * TABLES OPS000 OR OPS300 TO GET MNEMONIC.
                *
                        LXI     H,STSCAN    ;PNTR TO SCAN START
                        LDA     INST        ;GET 1ST OPCODE BYTE
XSCAN   PUSH    PSW
SCAN    DCX     H
                        MOV     A,M
                        SUI     $80         ;INDEX BYTE TEST
                        JM      SCAN        ;NOT INDEX SO LOOP
                        POP     PSW
                        DCX     H           ;PNTR TO OPCODE BYTE
                        CMP     M           ;COMPARE 1ST INSTRUCTION BYTE
                        JZ      FOUND       ;TO TABLE OPCODE BYTE.
                        JMP     XSCAN       ;LOOK FOR NEXT OPCODE BYTE
                *
FOUND   INX     H
                        MOV     A,M         ;GET INDEX BYTE FROM TABLE
                        PUSH    PSW
                        PUSH    PSW
                        ANI     7           ;GET MNEM BYTE COUNT
                        STA     MCNT        ;SAVE IT HERE
                        MOV     B,A         ;AND HERE
                        POP     PSW         ;GET INSTR BYTE
                        RRC
                        RRC
                        RRC
                        ANI     3           ;GET SPACE COUNT
                        MOV     B,A
                        MOV     C,A
                        MVI     A,5         ;COMPUTE # BYTES IN
                        SUB     B           ;MNEMONIC MAIN WORD.
                        MOV     B,A         ;SAVE WORD COUNT IN B
                        POP     PSW
                        PUSH    B
                        RLC
                        RLC
                        RLC
                        ANI     3
                        STA     NBR
                *
                * TAKE MNEMONIC FROM LOOK-UP TABLE
                * AND PUT IT INTO OUTPUT BUFFER (LIN).
                * INSERT ANY REQUIRED SPACES.
                *
                        LXI     D,LIN+26
CHAR    INX     H
                        MOV     A,M
                        STAX    D
                        INX     D
                        DCR     B
                        JNZ     CHAR
SPAC    INX     D
                        DCR     C
                        JNZ     SPAC
                        LDA     MCNT
                        POP     B
                        SUB     B
                        JZ      OUTLIN
APND    INX     H
                        MOV     A,M
                        STAX    D
                        INX     D
                        DCR     B
                        JNZ     APND
                *
                * PUT INSTRUCTION CODE INTO OUTPUT
                * BUFR AND PRINT CONTENTS OF BUFFER.
                *
OUTLIN  LDA     NBR
                        MOV     B,A
                        LXI     D,INST
                        LXI     H,LIN+6
ANOTH   LDAX    D
                        CALL    CBH
                        DCR     B
                        INX     D
                        INX     H
                        PUSH    H
                        LHLD    ADDR
                        INX     H
                        SHLD    ADDR
                        POP     H
                        JNZ     ANOTH
                        CALL    CRLF        ;ALL DATA IN LIN
                        LXI     H,LIN       ;PREPARE TO OUTPUT IT.
                        CALL    PDATA
                        LDA     MODE
                        CPI     $FF         ;TEST MODE BYTE
                        JNZ     AUTO        ;00 INDICATES AUTOMATIC
                        CALL    INCHR       ;WAIT FOR OPER CMND
                        CPI     'S'         ;TEST FOR STOP COMND
                        JZ      MONIT
                        CPI     'A'         ;TEST FOR AUTO COMND. AUTO
                        JNZ     AUTO        ;MODE CAN BE EXITED ONLY BY
                        XRA     A           ;HARDWARE RESET.
                        STA     MODE
AUTO    LHLD    ADDR
                        JMP     CONTIN
                *
                * INSTR CODE #1 BYTE IS CLASSIFIED TO
                * DETERMINE WHICH PROCESSING ROUTINE
                * WILL BE USED TO GET MNEMONIC AND BYTE
                * COUNT. RETURN TO CALLING PROGRAM.
                *
DECODE  MVI     A,1
                        STA     NBR
                        LDA     INST
                        RLC
                        RLC
                        ANI     3
                        SUI     2
                        JZ      GR2
                        RP
                        ADI     1
                        JZ      GR1
                *
GR0     LDA     INST
                        ANI     7
                        CPI     4           ;TEST FOR INR
                        JNZ     TDCR
                        LXI     D,INR
                        CALL    GET3
                        JMP     ADDONE
                *
TDCR    CPI     5
                        JNZ     TMVI
                        LXI     D,DCR
                        CALL    GET3
                        JMP     ADDONE
                *
TMVI    CPI     6
                        JNZ     GR000
                        MVI     A,2
                        STA     NBR
                        LXI     D,MVI
                        CALL    GET3
                        JMP     ADDONE
                *
GR000   ANA     A           ;CLEAR CARRY
                        RET
                *
GR1     LDA     INST
                        CPI     $76         ;TEST FOR HLT
                        JNZ     ISMOV
                        LXI     D,HLT
                        CALL    GET3
                        STC
                        RET
                *
ISMOV   PUSH    PSW
                        PUSH    PSW
                        LXI     D,MOV
                        CALL    GET3
                        POP     PSW
                        ANI     $38
                        RRC
                        RRC
                        RRC
                        CALL    GET1
                        STA     LIN+31
                        MVI     A,','
                        STA     LIN+32
                        POP     PSW
                        ANI     7
                        CALL    GET1
                        STA     LIN+33
                        STC
                        RET
                *
GR2     LDA     INST
                        PUSH    PSW
                        LXI     D,OPS200
                        ANI     $38
                        RRC
                        ADC     E
                        MOV     E,A
                        CALL    GET3
                        POP     PSW
                        ANI     7
                        CALL    GET1
                        STA     LIN+31
                        STC
                        RET
                *
GET1    LXI     D,OPS200
                        INX     D
                        INX     D
                        INX     D
                        RLC
                        RLC
                        ADC     E
                        MOV     E,A
                        LDAX    D
                        RET
                *
GET3    MVI     B,3
```

```
265  6962 21 62 6F          LXI    H,LIN+26
266  6965 1A        GETMOR  LDAX   D
267  6966 77                MOV    M,A
268  6967 13                INX    D
269  6968 23                INX    H
270  6969 05                DCR    B
271  696A CA 70 69          JZ     DONE
272  696D C3 65 69          JMP    GETMOR
273  6970 C9        DONE    RET
274                         *
275                         * CONVERT BINARY BYTE IN REG A TO 2 HEX
276                         * CHARS. SAVE IN ADDR POINTED TO BY H,L.
277                         *
278  6971 F5        CBH     PUSH   PSW
279  6972 CD 55 6C          CALL   HEXL
280  6975 77                MOV    M,A
281  6976 F1                POP    PSW
282  6977 23                INX    H
283  6978 CD 59 6C          CALL   HEXR
284  697B 77                MOV    M,A
285  697C 23                INX    H
286  697D C9                RET
287                         *
288  697E 3A 44 6F  ADDONE  LDA    INST
289  6981 E6 38             ANI    $38
290  6983 1F                RAR
291  6984 1F                RAR
292  6985 1F                RAR
293  6986 CD 54 69          CALL   GET1
294  6989 32 67 6F          STA    LIN+31
295  698C 37                STC
296  698D C9                RET
297                         *
298                         * FILL OUTPUT BUFR WITH ASCII SPACE CHARS.
299                         *
300  698E 21 48 6F  SPACES  LXI    H,LIN
301  6991 06 27             MVI    B,$27
302  6993 36 20     SP      MVI    M,$20
303  6995 05                DCR    B
304  6996 23                INX    H
305  6997 C2 93 69          JNZ    SP
306  699A 3E 04             MVI    A,4        ;END OF LINE CHAR
307  699C 32 6F 6F          STA    LIN+39
308  699F C9                RET
309                         *
310  69A0                   ORG    $69A0
311                         *
312                         * MNEMONIC LOOK-UP TABLES.
313                         *
314                         * OPS000
315  69A0 00 B3             DB     0,$B3
316  69A2 4E 4F 50          DB     'NOP'
317  69A5 01 F4             DB     1,$F4
318  69A7 4C 58 49          DB     'LXIB'
     69AA 42
319  69AB 02 AD             DB     2,$AD
320  69AD 53 54 41          DB     'STAXB'
     69B0 58 42
321  69B2 03 B4             DB     3,$B4
322  69B4 49 4E 58          DB     'INXB'
     69B7 42
323  69B8 07 B3             DB     7,$B3
324  69BA 52 4C 43          DB     'RLC'
325  69BD 08 B3             DB     $8,$B3
326  69BF 2A 2A 2A          DB     '***'
327  69C2 09 B4             DB     $9,$B4
328  69C4 44 41 44          DB     'DADB'
     69C7 42
329  69C8 0A AD             DB     $A,$AD
330  69CA 4C 44 41          DB     'LDAXB'
     69CD 58 42
331  69CF 0B B4             DB     $B,$B4
332  69D1 44 43 58          DB     'DCXB'
     69D4 42
333  69D5 0F B3             DB     $F,$B3
334  69D7 52 52 43          DB     'RRC'
335  69DA 10 B3             DB     $10,$B3
336  69DC 2A 2A 2A          DB     '***'
337  69DF 11 F4             DB     $11,$F4
338  69E1 4C 58 49          DB     'LXID'
     69E4 44
339  69E5 12 AD             DB     $12,$AD
340  69E7 53 54 41          DB     'STAXD'
     69EA 58 44
341  69EC 13 B4             DB     $13,$B4
342  69EE 49 4E 58          DB     'INXD'
     69F1 44
343  69F2 17 B3             DB     $17,$B3
344  69F4 52 41 4C          DB     'RAL'
345  69F7 18 B3             DB     $18,$B3
346  69F9 2A 2A 2A          DB     '***'
347  69FC 19 B4             DB     $19,$B4
348  69FE 44 41 44          DB     'DADD'
     6A01 44
349  6A02 1A AD             DB     $1A,$AD
350  6A04 4C 44 41          DB     'LDAXD'
     6A07 58 44
351  6A09 1B B4             DB     $1B,$B4
352  6A0B 44 43 58          DB     'DCXD'
     6A0E 44
353  6A0F 1F B3             DB     $1F,$B3
354  6A11 52 41 52          DB     'RAR'
355  6A14 20 B3             DB     $20,$B3
356  6A16 2A 2A 2A          DB     '***'
357  6A19 21 F4             DB     $21,$F4
358  6A1B 4C 58 49          DB     'LXIH'
     6A1E 48
359  6A1F 22 EC             DB     $22,$EC
360  6A21 53 48 4C          DB     'SHLD'
     6A24 44
361  6A25 23 B4             DB     $23,$B4
362  6A27 49 4E 58          DB     'INXH'
     6A2A 48
363  6A2B 27 B3             DB     $27,$B3
364  6A2D 44 41 41          DB     'DAA'
365  6A30 28 B3             DB     $28,$B3
366  6A32 2A 2A 2A          DB     '***'
367  6A35 29 B4             DB     $29,$B4
368  6A37 44 41 44          DB     'DADH'
     6A3A 48
369  6A3B 2A EC             DB     $2A,$EC
370  6A3D 4C 48 4C          DB     'LHLD'
     6A40 44
371  6A41 2B B4             DB     $2B,$B4
372  6A43 44 43 58          DB     'DCXH'
     6A46 48
373  6A47 2F B3             DB     $2F,$B3
374  6A49 2A 2A 2A          DB     '***'
375  6A4C 31 F5             DB     $31,$F5
376  6A4E 4C 58 49          DB     'LXISP'
     6A51 53 50
377  6A53 32 F3             DB     $32,$F3
378  6A55 53 54 41          DB     'STA'
379  6A58 33 B5             DB     $33,$B5
380  6A5A 49 4E 58          DB     'INXSP'
     6A5D 53 50
381  6A5F 37 B3             DB     $37,$B3
382  6A61 53 54 43          DB     'STC'
383  6A64 38 B3             DB     $38,$B3
384  6A66 2A 2A 2A          DB     '***'
385  6A69 39 B5             DB     $39,$B5
386  6A6B 44 41 44          DB     'DADSP'
     6A6E 53 50
387  6A70 3A F3             DB     $3A,$F3
388  6A72 4C 44 41          DB     'LDA'
389  6A75 3B B5             DB     $3B,$B5
390  6A77 44 43 58          DB     'DCXSP'
     6A7A 53 50
391  6A7C 3F B3             DB     $3F,$B3
392  6A7E 43 4D 43          DB     'CMC'
393                         * OPS300
394  6A81 C0 B3             DB     $C0,$B3
395  6A83 52 4E 5A          DB     'RNZ'
396  6A86 C1 B4             DB     $C1,$B4
397  6A88 50 4F 50          DB     'POPB'
     6A8B 42
398  6A8C C2 F3             DB     $C2,$F3
399  6A8E 4A 4E 5A          DB     'JNZ'
400  6A91 C3 F3             DB     $C3,$F3
401  6A93 4A 4D 50          DB     'JMP'
402  6A96 C4 F3             DB     $C4,$F3
403  6A98 43 4E 5A          DB     'CNZ'
404  6A9B C5 AD             DB     $C5,$AD
405  6A9D 50 55 53          DB     'PUSHB'
     6AA0 48 42
406  6AA2 C6 D3             DB     $C6,$D3
407  6AA4 41 44 49          DB     'ADI'
408  6AA7 C7 B4             DB     $C7,$B4
409  6AA9 52 53 54          DB     'RST0'
     6AAC 30
410  6AAD C8 BA             DB     $C8,$BA
411  6AAF 52 5A             DB     'RZ'
412  6AB1 C9 B3             DB     $C9,$B3
413  6AB3 52 45 54          DB     'RET'
414  6AB6 CA FA             DB     $CA,$FA
415  6AB8 4A 5A             DB     'JZ'
416  6ABA CB B3             DB     $CB,$B3
417  6ABC 2A 2A 2A          DB     '***'
418  6ABF CC FA             DB     $CC,$FA
419  6AC1 43 5A             DB     'CZ'
420  6AC3 CD EC             DB     $CD,$EC
421  6AC5 43 41 4C          DB     'CALL'
     6AC8 4C
422  6AC9 CE D3             DB     $CE,$D3
423  6ACB 41 43 49          DB     'ACI'
424  6ACE CF B4             DB     $CF,$B4
425  6AD0 52 53 54          DB     'RST1'
     6AD3 31
426  6AD4 D0 B3             DB     $D0,$B3
427  6AD6 52 4E 43          DB     'RNC'
428  6AD9 D1 B4             DB     $D1,$B4
429  6ADB 50 4F 50          DB     'POPD'
     6ADE 44
430  6ADF D2 F3             DB     $D2,$F3
431  6AE1 4A 4E 43          DB     'JNC'
432  6AE4 D3 D3             DB     $D3,$D3
433  6AE6 4F 55 54          DB     'OUT'
434  6AE9 D4 F3             DB     $D4,$F3
435  6AEB 43 4E 43          DB     'CNC'
436  6AEE D5 AD             DB     $D5,$AD
437  6AF0 50 55 53          DB     'PUSHD'
     6AF3 48 44
438  6AF5 D6 D3             DB     $D6,$D3
439  6AF7 53 55 49          DB     'SUI'
```

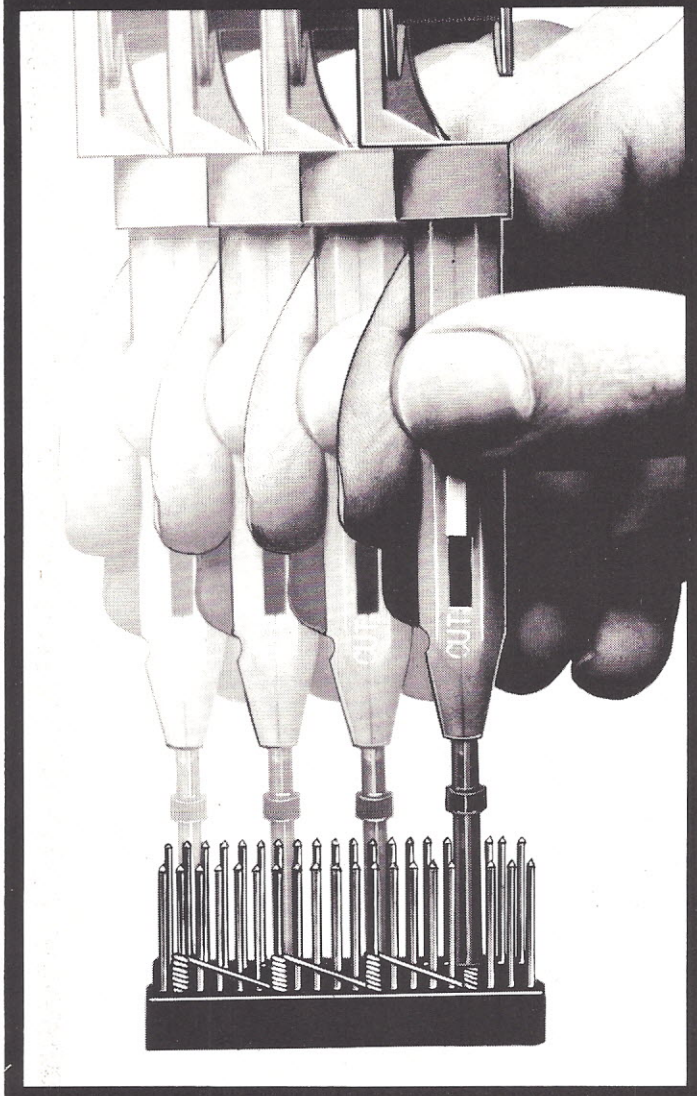
```
440   6AFA D7 B4              DB      $D7,$B4
441   6AFC 52 53 54           DB      'RST2'
      6AFF 32
442   6B00 D8 BA              DB      $D8,$BA
443   6B02 52 43              DB      'RC'
444   6B04 D9 B3              DB      $D9,$B3
445   6B06 2A 2A 2A           DB      '***'
446   6B09 DA FA              DB      $DA,$FA
447   6B0B 4A 43              DB      'JC'
448   6B0D DB DA              DB      $DB,$DA
449   6B0F 49 4E              DB      'IN'
450   6B11 DC FA              DB      $DC,$FA
451   6B13 43 43              DB      'CC'
452   6B15 DD B3              DB      $DD,$B3
453   6B17 2A 2A 2A           DB      '***'
454   6B1A DE D3              DB      $DE,$D3
455   6B1C 53 42 49           DB      'SBI'
456   6B1F DF B4              DB      $DF,$B4
457   6B21 52 53 54           DB      'RST3'
      6B24 33
458   6B25 E0 B3              DB      $E0,$B3
459   6B27 52 50 4F           DB      'RPO'
460   6B2A E1 B4              DB      $E1,$B4
461   6B2C 50 4F 50           DB      'POPH'
      6B2F 48
462   6B30 E2 F3              DB      $E2,$F3
463   6B32 4A 50 4F           DB       JPO'
464   6B35 E3 AC              DB      $E3,$AC
465   6B37 58 54 48           DB      'XTHL'
      6B3A 4C
466   6B3B E4 F3              DB      $E4,$F3
467   6B3D 43 50 4F           DB      'CPO'
468   6B40 E5 AD              DB      $E5,$AD
469   6B42 50 55 53           DB      'PUSHH'
      6B45 48 48
470   6B47 E6 D3              DB      $E6,$D3
471   6B49 41 4E 49           DB      'ANI'
472   6B4C E7 B4              DB      $E7,$B4
473   6B4E 52 53 54           DB      'RST4'
      6B51 34
474   6B52 E8 B3              DB      $E8,$B3
475   6B54 52 50 45           DB      'RPE'
476   6B57 E9 AC              DB      $E9,$AC
477   6B59 50 43 48           DB      'PCHL'
      6B5C 4C
478   6B5D EA F3              DB      $EA,$F3
479   6B5F 4A 50 45           DB      'JPE'
480   6B62 EB AC              DB      $EB,$AC
481   6B64 58 43 48           DB      'XCHG'
      6B67 47
482   6B68 EC F3              DB      $EC,$F3
483   6B6A 43 50 45           DB      'CPE'
484   6B6D ED B3              DB      $ED,$B3
485   6B6F 2A 2A 2A           DB      '***'
486   6B72 EE D3              DB      $EE,$D3
487   6B74 58 52 49           DB      'XRI'
488   6B77 EF B4              DB      $EF,$B4
489   6B79 52 53 54           DB      'RST5'
      6B7C 35
490   6B7D F0 BA              DB      $F0,$BA
491   6B7F 52 50              DB      'RP'
492   6B81 F1 B6              DB      $F1,$B6
493   6B83 50 4F 50           DB      'POPPSW'
      6B86 50 53 57
494   6B89 F2 FA              DB      $F2,$FA
495   6B8B 4A 50              DB      'JP'
496   6B8D F3 BA              DB      $F3,$BA
497   6B8F 44 49              DB      'DI'
498   6B91 F4 FA              DB      $F4,$FA
499   6B93 43 50              DB      'CP'
500   6B95 F5 AF              DB      $F5,$AF
501   6B97 50 55 53           DB      'PUSHPSW'
      6B9A 48 50 53
      6B9D 57
502   6B9E F6 D3              DB      $F6,$D3
503   6BA0 4F 52 49           DB      'ORI'
504   6BA3 F7 B4              DB      $F7,$B4
505   6BA5 52 53 54           DB      'RST6'
      6BA8 36
506   6BA9 F8 BA              DB      $F8,$BA
507   6BAB 52 4D              DB      'RM'
508   6BAD F9 AC              DB      $F9,$AC
509   6BAF 53 50 48           DB      'SPHL'
      6BB2 4C
510   6BB3 FA FA              DB      $FA,$FA
511   6BB5 4A 4D              DB      'JM'
512   6BB7 FB BA              DB      $FB,$BA
513   6BB9 45 49              DB      'EI'
514   6BBB FC FA              DB      $FC,$FA
515   6BBD 43 4D              DB      'CM'
516   6BBF FD B3              DB      $FD,$B3
517   6BC1 2A 2A 2A           DB      '***'
518   6BC4 FE D3              DB      $FE,$D3
519   6BC6 43 50 49           DB      'CPI'
520   6BC9 FF B4              DB      $FF,$B4
521   6BCB 52 53 54           DB      'RST7'
      6BCE 37
522                   *
523   6BCF            STSCAN  DS      1
524                   *
525   6BD0 41 44 44   OPS200  DB      'ADDB'
      6BD3 42
526   6BD4 41 44 43           DB      'ADCC'
      6BD7 43
527   6BD8 53 55 42           DB      'SUBD'
      6BDB 44
528   6BDC 53 42 42           DB      'SBBE'
      6BDF 45
529   6BE0 41 4E 41           DB      'ANAH'
      6BE3 48
530   6BE4 58 52 41           DB      'XRAL'
      6BE7 4C
531   6BE8 4F 52 41           DB      'ORAM'
      6BEB 4D
532   6BEC 43 4D 50           DB      'CMPA'
      6BEF 41
533                   *
534   6BF0 49 4E 52   INR     DB      'INR'
535   6BF3 44 43 52   DCR     DB      'DCR'
536   6BF6 4D 56 49   MVI     DB      'MVI'
537                   *
538   6BF9 4D 4F 56   MOV     DB      'MOV'
539   6BFC 48 4C 54   HLT     DB      'HLT'
540                   *
541                   END
```

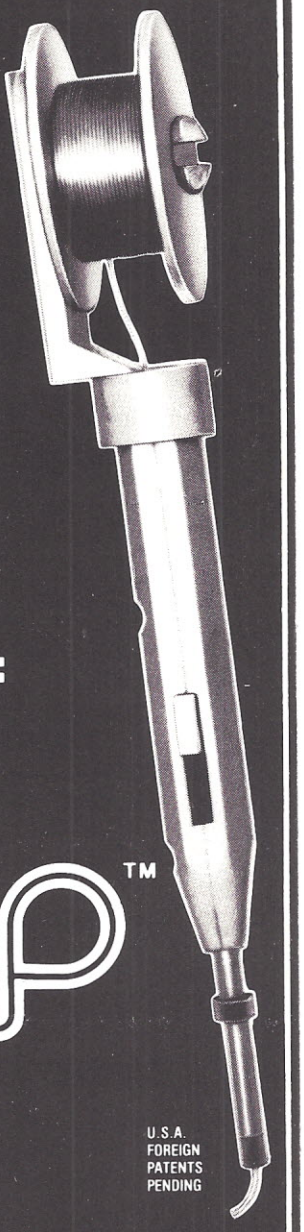
SYMBOL TABLE:

ADDM	6F40	ADDONE	697E	ADDR	6F42	ANOTH	687E	APND	686C
AUTO	68B3	CBH	6971	CHAR	6856	CONTIN	67F4	CRLF	6C11
DCR	6BF3	DECODE	68B9	DONE	6970	ENTER	67DF	FOUND	6833
GET1	6954	GET3	6960	GETMOR	6965	GR0	68D0	GR000	6904
GR1	6906	GR2	693A	HEXL	6C55	HEXR	6C59	HLT	6BFC
IN4H	6C4C	INCHR	6C1D	INR	6BF0	INST	6F44	ISMOV	6916
LIN	6F48	MCNT	6F3E	MODE	6F3F	MONIT	6EDB	MOV	6BF9
MS1	6DB4	MVI	6BF6	NBR	6F47	OPER	6F45	OPS200	6BD0
OUTLIN	6874	PDATA	6C03	SCAN	6823	SP	6993	SPAC	685E
SPACES	698E	STACK	6FB0	STSCAN	6BCF	TDCR	68E3	TMVI	68F1
XSCAN	6822								

Note: CONOPS works only with the H8 console driver as originally supplied by Heath. The new console driver, used in the H8-18 software package (Heath's #890-3-3), is different and I don't know how to use it yet.

NEW!





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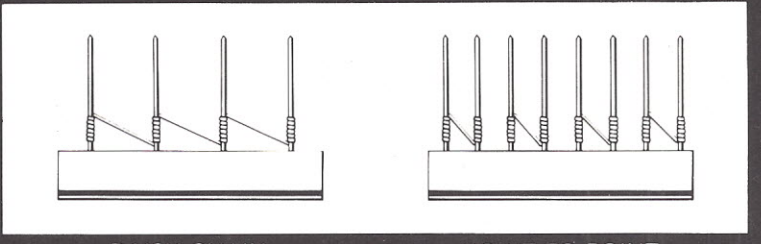

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Software Clock for the 6800

With this routine, you have instant access to the correct date and time—in ASCII format.

```
                        *       SOFTWARE CLOCK PROGRAM
                        *
A000                    IRQ     EQU     $A000
8101                    PIADB   EQU     $8101       PIA B PORT DATA REGISTER
8109                    PIACB   EQU     $8109       PIA CONTROL REGISTER B PORT
8300                    CIOS    EQU     $8300       ACIA CONTROL AND STATUS REGISTER
8301                    CIOD    EQU     CIOS+1      DATA REGISTER OF ACIA
                        *
0800                    ORG     $800
0800                    KTIME   RMB     1           VARIABLE TO COUNT 60 HZ INTERRUPT
0801                    UDAY1   RMB     1
0802                    TDAY1   RMB     1
0803                    UMON1   RMB     1
0804  48 52 20 20       HR      FCC     /HR  */
0808  2A
0809  4D 49 4E 20       MIN     FCC     /MIN */
080D  2A
080E  53 45 43 20       SEC     FCC     /SEC */
0812  2A
0813  4D 4F 20 20       MO      FCC     /MO  */
0817  2A
0818  44 41 59 20       DAY     FCC     /DAY */
081C  2A
081D  59 52 20 20       YR      FCC     /YR  */
0821  2A
                        *
0822  20 20             DT      FCC     /  /
0824  30                THRS    FCB     $30
0825  30                UHRS    FCB     $30
0826  3A                        FCC     /:/
0827  30                TMIN    FCB     $30
0828  30                UMIN    FCB     $30
0829  3A                        FCC     /:/
082A  30                TSEC    FCB     $30
082B  30                USEC    FCB     $30
082C  20 20 20 20               FCC     /
0830  20
0831  30                TMON    FCB     $30
0832  30                UMON    FCB     $30
0833  2F                        FCB     $2F         SLASH
0834  30                TDAY    FCB     $30
0835  30                UDAY    FCB     $30
0836  2F                        FCB     $2F         SLASH
0837  30                TYRS    FCB     $30
0838  30                UYRS    FCB     $30
0839  0D 0D 0A 2A               FCB     $0D,$0D,$0A,!*
```

Listing 1. Assignment of variables for the remainder of the program. A terminal interfaced to an ACIA at $8300 is indicated, as well as a PIA at $8101 through which the interrupts are serviced. The ASCII time and date sentence is shown beginning at $0822.

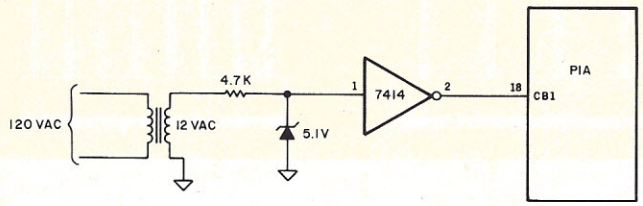

Fig. 1. The timebase for the software real-time clock can be derived from the commercial power line timebase of 60 Hz. The program allows virtually any other frequency to be used as well.

Whenever a computer is interfaced to the real world via sensors or a controllable device, there is often a need for the computer to know what time it is. Controlling a particular device at a specific time is one such use (for example, turning home lights on or off).

Another use might be appending the time to a particular event. My need fell into this latter category. In my computer-controlled security system, I am able to append both the time and the date to an event. For example, if the telephone or doorbell rings, the event will be noted on a printer along with the time and date.

My second need for a real-time clock was for an amateur radioteletype program. In this case, I wanted the computer to insert the time and date when I typed a particular control character. This article is the result of my labors and should prove useful to others, for it is, in some ways, a unique real-time clock program.

Program Description

Three characteristics of the program make it unique from many of the other articles written on the subject. The salient difference between this program and many of the others lies in the format in which the time is stored. Most programs store the time in packed BCD form.

At first, you might think that this is an efficient manner in which to store the time, for it requires very little memory. However, the disadvantage is that several other routines are required to retrieve the time, and print is in a form that can be read on paper. For example, the packed BCD digits must be separated, converted to ASCII, and then colons, spaces, slashes and perhaps a carriage return and line feed must be added to give the necessary readable output format.

The format used in this program has all the necessary characters and commands, and all you have to do is access the string of continuous addresses whenever the time and date are required. In essence, this format is a sentence that can be appended to virtually any event (for example, 12:17:36 06/21/79).

A second characteristic of this program is that it contains the month, day and year information, which most other programs lack. This is a particularly important feature for a security system or any other continuously run system. Only during a leap year or a new decade is there a need for human intervention. However, it's obvious that a little extra programming could ob-

viate this requirement.

The third difference is the way in which the time is initialized. Most other programs that I have seen require the user to access particular memory locations and insert the time and date in packed BCD form employing the user's operating system.

The method used in this program is far simpler and quicker. All the necessary prompts are given so that there is little chance for error. For example, the time indicated above could have been initialized by the following:

HR	4612
MIN	517
SEC	36
MO	06
DAY	21
YR	7879

When the program begins, the computer will respond by printing the HR prompt on the terminal, at which time the operator inserts the hour desired. If you make an error, merely continue by inserting the correct hour. The program has been written to accept only the last two digits. For example, in the above example, 12 hours rather than 46 will be the starting time. Likewise, the number of minutes will be 17, and the year 79.

When the correct digits have been inserted after a particular prompt, a carriage return will bring up the next prompt. The program has been written so that only valid ASCII numbers will be accepted, in other words, alpha or control characters will not be inserted or echoed back to the terminal. The carriage return after the YR prompt will clear the interrupt mask bit, which was set upon entrance into the program, and the MPU will begin servicing interrupts.

Therefore, the time can be initialized, and when that moment actually occurs, a carriage return command will synchronize the program with the real time. Since an IRQ interrupt, rather than an NMI interrupt, is used, there is no need to inhibit pulses during the loading or initialization of the program.

Finally, the program does not make any calls to the user's operating system subroutines such as MIKBUG's OUT2HS or PDATA1. For this reason, the program is independent of the user's operating system, and, therefore, it should be compatible with virtually any system using the 6800.

With initialization complete, the program branches to the CHRIN subroutine, which waits for a character from the terminal. If the character is a T, the time and date sentence is printed. This is the clock demonstration routine and is included for testing purposes. When the user is satisfied with the operation of the program, control should be transferred to the user's main program rather than the clock demonstration routine, which begins at $0869.

Hardware

Before you implement a real-time clock, you should first determine whether it will be a hardware or software clock. Each has its advantages and disadvantages. Briefly, the salient advantage of the software clock is the cost. Since there is virtually no hardware required, there is essentially no cost involved. On the other hand, a software clock does require more memory than a hardware clock, and it typically uses more of the computer's time. This impediment is so slight as to be nonexistent (more on this later).

The hardware clock is more advantageous when the computer is not run continuously, since loading and initialization are not required each time the computer is turned on. Since my

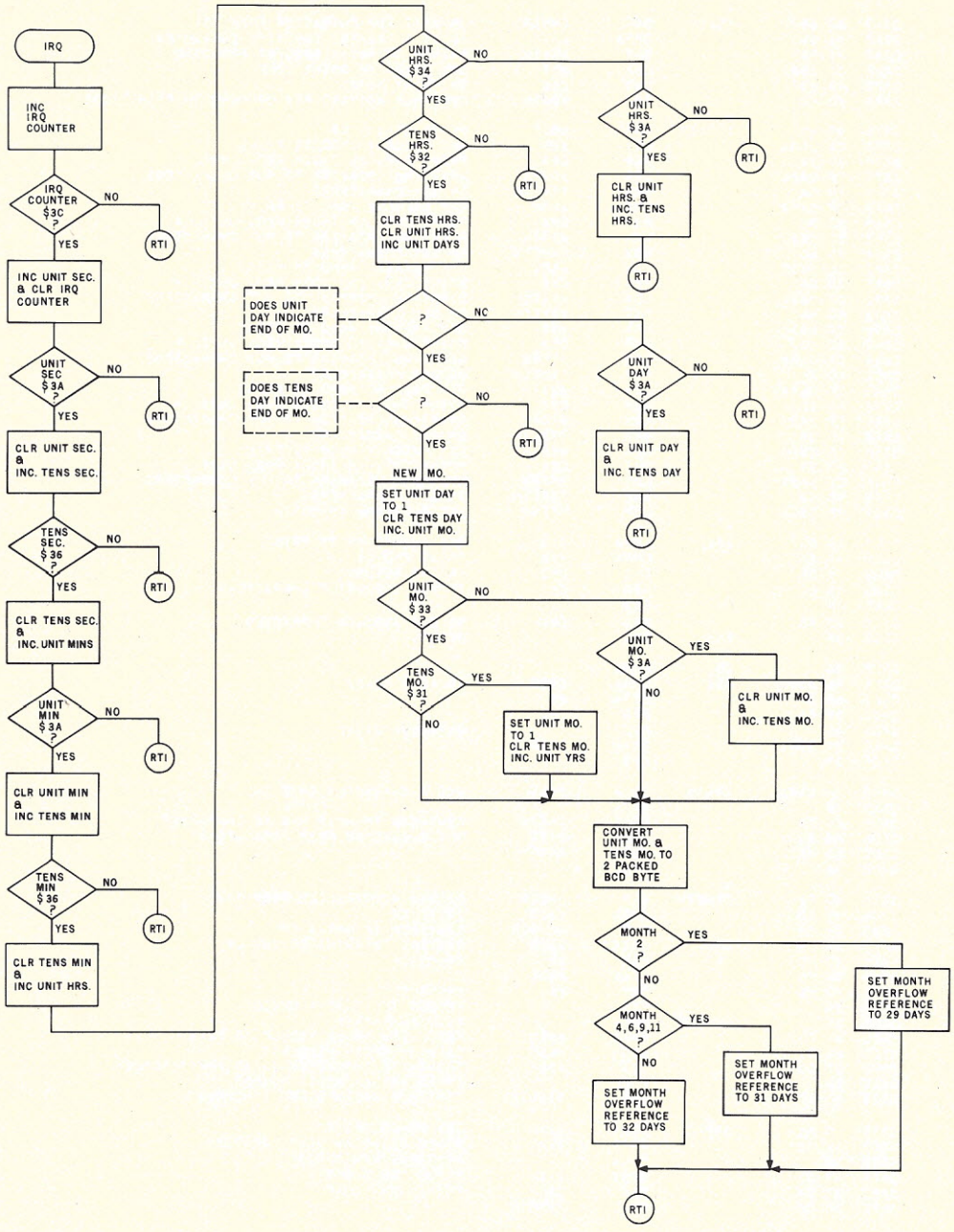

Fig. 2. Flowchart for the main portion of the program shown in listing 3. This, together with the comments in the listings, should allow non-6800 owners to design a similar program. Note that all variables are in ASCII and that, basically, the program checks for an overflow condition of the variables. For example, if units of seconds overflows from 9($39) to :($3A), there will then be a need to reset units of seconds back to 0($30) and increment tens of seconds and check for an overflow of 6($36).

security system computer is on continuously, the advantages of the software clock outweighed the disadvantages.

After deciding on a software clock, you must ask if the nonmaskable interrupt (NMI) or the interrupt request (IRQ) line of the 6800 should be used. Once again, each method has advantages and disadvantages.

The NMI interface method does not require an additional IC, such as a peripheral interface adapter (PIA), since it interfaces directly to the 6800. However, this method can cause problems in some applications. For example, if an ongoing program uses the MPU for timing loops, the accuracy of the timing loop will be impaired due to the overhead time of the clock program.

A second deficiency of this method lies in the fact that there must be a means of disabling the interrupts (i.e., a switch) until the program is loaded. This can be partially overcome by burning the program into ROM, but then other problems arise since the NMI vectored address must also be in nonvolatile memory. While this is certainly possible, the flexibility of the computer system would be slightly impaired. Finally, a typical system has several IRQ inputs, but only one NMI input. Therefore, the NMI cannot be used for other purposes.

For these reasons, I used a "soft" interrupt (IRQ) via a PIA. More specifically, as shown in Fig. 1, the interrupts were interfaced via the CB1 control line of the PIA. The data register of the B port of this PIA is at $8101, and the control register is at $8109. Of course, any PIA can be used with the necessary addresses altered in the program. The program assumes that the system's terminal is interfaced to the MPU via an ACIA with control and status register at $8300, and the data register at $8301.

The timebase for the interrupts is derived from conventional 60 Hz commercial power. While virtually any timebase can be used, this timebase source has the advantage that it is accurate, reliable and readily available. Fig. 1 gives the details of the timebase circuit. A 12 V ac transformer is indicated, but a standard 6.3 V ac filament transformer should prove equally acceptable. The 7414 is a Schmitt trigger inverter, which provides the necessary hysteresis to prevent false interrupts due to power-line fluctuations.

The output of the circuit is a clean, TTL-compatible signal at a 60 Hz repetition rate. The software provides the necessary dividing to give a 1 Hz timebase for seconds. Note that the computer system will be more efficient with a lower interrupt rate. For example, assuming a 1 MHz MPU clock frequency, each time an interrupt occurs, approximately 100 microseconds are

```
0850                    ORG     $850
0850  0F        BEGIN   SEI
0851  CE 0900           LDX     #START
0854  FF A000           STX     IRQ         IRQ INTERRUPT VECTORED ADDRESS
0857  4F                CLRA
0858  97 0800           STAA    KTIMF       INITIALIZE 60 HZ INTERRUPT COUNTER
085B  97 8109           STAA    PIA0CB      GET DDR
085E  97 8101           STAA    PIA0DB      B PORT OF PIA ALL INPUTS
0861  86 05             LDAA    #5
0863  B7 8109           STAA    PIA0CB      ENABLE CB1 INTERRUPT
                *
0866  8D 0E             BSR     INITIM      GO INITIALIZE TIME
0868  0E                CLI
                *
0869  8D 65    AGAIN   BSR     CHRIN       GO WAIT FOR CHARACTER FROM TTY
086B  81 54             CMPA    #'T         IS IT A REQUEST FOR TIME CHARACTER
086D  26 FA             BNE     AGAIN       BRANCH IF NOT A REQUEST FOR TIME
086F  CE 0822           LDX     #DT         GET READY TO PRINT TIME
0872  8D 43             BSR     C0X         GO PRINT TIME
0874  20 F3             BRA     AGAIN       CONTINUE WAITING FOR COMMAND TO PRINT TIME
                *
0876  8D 6A     INITIM  BSR     CRLF        PRINT CR AND LF
0878  CE 0804           LDX     #HR         GET PRESENT WORD TO PRINT
087B  8D 3A             BSR     C0X         PRINT CHR, IN INDEX REG, UNTIL *
087D  CE 0824           LDX     #THRS       STARTING LOCATION TO PUT CHARACTERS
0880  8D 5A             BSR     TIMEIN      GO GET CHARACTERS
0882  CE 0809           LDX     #MIN        GET PRESENT WORD TO PRINT
0885  8D 30             BSR     C0X         PRINT CHR, IN INDEX REG, UNTIL *
0887  CE 0827           LDX     #TMIN       STARTING LOCATION TO PUT CHARACTERS
088A  8D 50             BSR     TIMEIN      GO GET CHARACTERS
088C  CE 080E           LDX     #SEC        GET PRESENT WORD TO PRINT
088F  8D 26             BSR     C0X         PRINT CHR, IN INDEX REG, UNTIL *
0891  CE 082A           LDX     #TSEC       STARTING LOCATION TO PUT CHARACTERS
0894  8D 46             BSR     TIMEIN      GO GET CHARACTERS
0896  CE 0813           LDX     #M0         GET PRESENT WORD TO PRINT
0899  8D 1C             BSR     C0X         PRINT CHR, IN INDEX REG, UNTIL *
089B  CE 0831           LDX     #TM0N       STARTING LOCATION TO PUT CHARACTERS
089E  8D 3C             BSR     TIMEIN      GO GET CHARACTERS
08A0  CE 0818           LDX     #DAY        GET PRESENT WORD TO PRINT
08A3  8D 12             BSR     C0X         PRINT CHR, IN INDEX REG, UNTIL *
08A5  CE 0834           LDX     #TDAY       STARTING LOCATION TO PUT CHARACTERS
08A8  8D 32             BSR     TIMEIN      GO GET CHARACTERS
08AA  CE 081D           LDX     #YR         GET PRESENT WORD TO PRINT
08AD  8D 08             BSR     C0X         PRINT CHR, IN INDEX REG, UNTIL *
08AF  CE 0837           LDX     #TYRS       STARTING LOCATION TO PUT CHARACTERS
08B2  8D 28             BSR     TIMEIN      GO GET CHARACTERS
08B4  7E 09C4           JMP     MTEST       SET OVERFLOW TO MONTH
                *
08B7  A6 00     C0X     LDAA    0,X         GET CHARACTER TO PRINT
08B9  81 2A             CMPA    #'*         IS IT END ,*
08BB  27 05             BEQ     END         IF END,RETURN
08BD  8D 04             BSR     C0          IF NOT END,PRINT CHARACTERS
08BF  08                INX
08C0  20 F5             BRA     C0X         GO GET ANOTHER CHARACTER
08C2  39        END     RTS                 RETURN
                *
08C3  36        C0      PSHA
08C4  B6 8300   C01     LDAA    CIOS        IS ACIA READY
08C7  85 02             BITA    #2
08C9  27 F9             BEQ     C01
08CB  32                PULA                RETRIEVE DIGIT
08CC  B7 8301           STAA    CIOD
08CF  39                RTS
                *
08D0  B6 8300   CHRIN   LDAA    CIOS        HAS A CHARACTER COME IN
08D3  47                ASRA
08D4  24 FA             BCC     CHRIN       CONTINUE IF ACIA HAS NO CHARACTER
08D6  B6 8301           LDAA    CIOD        GET CHARACTER FROM ACIA (TTY)
08D9  84 7F             ANDA    #$7F
08DB  39                RTS
                *
08DC  8D F2     TIMEIN  BSR     CHRIN       GO GET A CHARACTER FROM TTY
08DE  81 0D             CMPA    #$0D        IS IT CR
08E0  26 09             BNE     NUMBER      CONTINUE IF NOT A CR
08E2  86 0A     CRLF    LDAA    #$0A        ROUTINE TO PRINT CR AND LF
08E4  8D DD             BSR     C0          PRINT LF
08E6  86 0D             LDAA    #$0D
08E8  8D D9             BSR     C0          PRINT CR
08EA  39                RTS                 RETURN IF IT IS A SPACE
08EB  36        NUMBER  PSHA                SAVE CHARACTER
08EC  84 F0             ANDA    #$F0        FORCE LOW ORDER NIBBLE TO ZERO
08EE  88 30             EORA    #$30        IS HIGH ORDER NIBBLE 3
08F0  27 03             BEQ     AHEAD       BRANCH IF CHARACTER IS AN ASCII NUMBER
08F2  32                PULA                IT IS NOT AN ASCII NUMBER
08F3  20 E7             BRA     TIMEIN      CONTINUE WAITING FOR A NUMBER
                *
08F5  A6 01     AHEAD   LDAA    1,X         GET OTHER DIGIT
08F7  A7 00             STAA    0,X         STORE DIGIT AT NEXT LOCATION
08F9  32                PULA                RETRIEVE NEW DIGIT
08FA  A7 01             STAA    1,X         STORE NEW DIGIT
08FC  8D C5             BSR     C0          PRINT NEW DIGIT
08FE  20 DC             BRA     TIMEIN
```

Listing 2. Initialization portion of the program ($0850) where the program begins. This routine gives the operator the necessary prompts to insert the hours, seconds, minutes, etc. With the initialization complete, interrupts are enabled and the program waits for a "T" from the keyboard, at which time the time and date sentence is printed. This portion of the program may be removed.

used by the software clock routine. Thus, during a one-second period, the computer is called upon for 6 ms (.6 percent) to service the clock program. If you add an external hardware dividing circuit, such as a divide by 60 (i.e., Motorola MC14566) to give an interrupt only once a second, the 6 ms of overhead time will be reduced to 100 microseconds (.01 percent).

You can decide for yourself if the reduction in time is worth the extra effort of adding additional hardware. Bear in mind that the 100 microseconds of overhead time discussed above is an average. The worst case is approximately 400 microseconds, which occurs at the end of the year when all the variables roll over.

Software

The flowchart (Fig. 2) and the comments in the listings should be enough to give an explanation of the workings of the program. There are, however, a few points worthy of further clarification. When an interrupt occurs, the current status of the MPU is saved on the stack. The MPU then jumps to the location stored in location $FFF8 and $FFF9. In most systems using the 6800, this information is in nonvolatile memory. Therefore, the MPU is directed to another address in volatile memory, usually $A000 and $A001.

The second and third instructions in the program shown in Listing 2 show how $A000 and $A001 are initialized. In a system using multiple interrupts, the user will wish to alter this address to allow control to be transferred to an interrupt polling subroutine, which determines the origin of the interrupt.

As shown in Listing 1, the time and date sentence starts at location $0822 and ends at $083C. The last character is an asterisk (*), which is used as the end of transmission character. The subroutine COX prints the characters until it detects the asterisk and then returns. The number of spaces between the time and date, as well as the entire format of the sentence, may be altered, but this may require that the program be reas-

Listing 3. Heart of the software clock (see Fig. 2). Each time an interrupt occurs, the MPU is vectored to location START ($0900). If 60 interrupts have not occurred, the MPU will immediately return from the interrupt. However, if 60 interrupts have been counted, execution will continue and the time and date will be updated as necessary. If a timebase other than 60 Hz is used, merely change the operand of the CMPA instruction at location $0909.

```
                        *
0900  B6 8101    START   LDAA    PIAODB      CLEAR INTERRUPT FROM PIA
0903  7C 0800            INC     KTIME       ADD ONE TO INTERRUPT COUNTER
0906  B6 0800            LDAA    KTIME
0909  81 3C              CMPA    #60         WAIT FOR 60 INTERRUPTS
090B  27 01              BEQ     CLOCK       IF 60 INTERRUPTS PASSED GO TO CLOCK PROGRAM
090D  3B                 RTI
090E  7F 0800    CLOCK   CLR     KTIME
0911  C6 30              LDAB    #$30
0913  7C 0828            INC     USEC        ADD ONE TO UNIT SECONDS
0916  B6 0828            LDAA    USEC        LOAD ACC A WITH UNIT SECONDS
0919  88 3A              EORA    #$3A
091B  27 01              BEQ     ITSEC       UNIT SECONDS OVERFLOW, GO INC T SECS
091D  3B                 RTI
091E  7C 082A    ITSEC   INC     TSEC        INCREMENT TENS OF SECONDS
0921  F7 0828            STAB    USEC
0924  B6 082A            LDAA    TSEC
0927  88 36              EORA    #$36
0929  27 01              BEQ     IUMIN       TENS OF SECONDS OVERFLOW, INC U MIN
092B  3B                 RTI
092C  7C 0828    IUMIN   INC     UMIN        INCREMENT UNIT MINUTES
092F  F7 082A            STAB    TSEC
0932  B6 0828            LDAA    UMIN
0935  88 3A              EORA    #$3A
0937  27 01              BEQ     ITMIN       UNITS MINUTES OVERFLOW, INC T MIN
0939  3B                 RTI
093A  7C 0827    ITMIN   INC     TMIN        INCREMENT TENS OF MINUTES
093D  F7 0828            STAB    UMIN
0940  B6 0827            LDAA    TMIN
0943  88 36              EORA    #$36
0945  27 01              BEQ     IUHRS       TENS OF MINUTES OVERFLOW, INC U HRS
0947  3B                 RTI
0948  7C 0825    IUHRS   INC     UHRS        INCREMENT UNIT HOURS
094B  F7 0827            STAB    TMIN
094E  B6 0825            LDAA    UHRS
0951  81 34              CMPA    #$34
0953  27 0C              BEQ     ISIT2
0955  81 3A              CMPA    #$3A
0957  27 01              BEQ     ITHRS       UNIT HOURS OVERFLOW, INC T OF HRS
0959  3B                 RTI
095A  7C 0824    ITHRS   INC     THRS        INCREMENT TENS OF HOURS
095D  F7 0825            STAB    UHRS
0960  3B                 RTI
0961  B6 0824    ISIT2   LDAA    THRS
0964  81 32              CMPA    #$32
0966  27 01              BEQ     IUDAY       TENS OF HOURS OVERFLOW, INC U DAY
0968  3B                 RTI
0969  7C 0835    IUDAY   INC     UDAY        INCREMENT UNIT OF DAYS
096C  F7 0824            STAB    THRS
096F  F7 0825            STAB    UHRS
0972  B6 0835            LDAA    UDAY        LOAD ACC A WITH UNIT DAY
0975  B1 0801            CMPA    UDAY1       DOES UNIT DAY INDICATE END OF MONTH
0978  27 0C              BEQ     ISIT3       BRANCH, UNITS OF DAY INDICATES END OF MONTH
097A  81 3A              CMPA    #$3A
097C  27 01              BEQ     ITDAY       TENS OF DAYS OVERFLOW
097E  3B                 RTI
097F  7C 0834    ITDAY   INC     TDAY
0982  F7 0835            STAB    UDAY        RESET UDAY TO 0
0985  3B                 RTI
0986  B6 0834    ISIT3   LDAA    TDAY        LOAD ACC A WITH TDAY
0989  B1 0802            CMPA    TDAY1       DOES TEN OF DAY INDICATE END OF MONTH
098C  27 01              BEQ     NEWMO       NEW MONTH
098E  3B                 RTI
098F  7C 0832    NEWMO   INC     UMON
0992  F7 0835            STAB    UDAY        RESET DAY TO THE BEGINNING OF MONTH
0995  7C 0835            INC     UDAY
0998  F7 0834            STAB    TDAY        RESET DAY TO BEGINNING OF MONTH
099B  B6 0832            LDAA    UMON
099E  81 33              CMPA    #$33        DOES UNITS OF MONTH INDICATE END OF YEAR
09A0  27 0D              BEQ     ISIT4
09A2  81 3A              CMPA    #$3A
09A4  26 06              BNE     CONT1
09A6  7C 0831            INC     TMON
09A9  F7 0832            STAB    UMON
09AC  AD 16      CONT1   BSR     MTEST       WHAT IS THE NUMBER OF DAYS IN NEW MONTH
09AE  3B                 RTI
09AF  B6 0831    ISIT4   LDAA    TMON
09B2  81 31              CMPA    #$31
09B4  26 F6              BNE     CONT1
09B6  7C 083A            INC     UYRS        INCREMENT UNIT OF YEARS
09B9  F7 0832            STAB    UMON        RESET TO FIRST MONTH OF NEW YEAR
09BC  7C 0832            INC     UMON
09BF  F7 0831            STAB    TMON        REST TO FIRST MONTH OF NEW YEAR
09C2  20 E8              BRA     CONT1
                        *       FORM 2 PACKED BCD DIGITS FROM UNITS OF MO, AND TENS OF MO,
09C4  B6 0831    MTEST   LDAA    TMON
09C7  F6 0832            LDAB    UMON
09CA  C4 0F              ANDB    #$0F        SET BITS 4,5,6, AND 7 TO ZERO
09CC  F7 0803            STAB    UMON1
09CF  48                 ASLA
09D0  48                 ASLA
09D1  48                 ASLA
09D2  48                 ASLA
09D3  BA 0803            ORAA    UMON1
                        *
09D6  81 02      FEB     CMPA    #2
09D8  26 02              BNE     APRIL
09DA  20 21              BRA     M028        SET TO MONTH WITH 28 DAYS
09DC  81 04      APRIL   CMPA    #4
09DE  26 02              BNE     JUNE
09E0  20 26              BRA     M030        SET TO MONTH WITH 30 DAYS
09E2  81 06      JUNE    CMPA    #6
09E4  26 02              BNE     SEPT
09E6  20 20              BRA     M030        SET TO MONTH WITH 30 DAYS
09E8  81 09      SEPT    CMPA    #9
09EA  26 02              BNE     NOV
09EC  20 1A              BRA     M030        SET TO MONTH WITH 30 DAYS
09EE  81 11      NOV     CMPA    #$11
09F0  27 16              BEQ     M030
```

```
                    *                       IF THERE IS NO MATCH, IT MUST BE A MONTH
                    *                       WITH 31 DAYS
                    *                       MONTHS THAT HAVE 31 DAYS ARE
                    *                       JAN, MARCH, MAY, JULY, AUG, OCT, DEC
09F2  86 32         M031    LDAA    #$32
09F4  B7 0801               STAA    UDAY1
09F7  86 33                 LDAA    #$33
09F9  B7 0802               STAA    TDAY1
09FC  39                    RTS
09FD  86 39         M028    LDAA    #$39        FEBRUARY
09FF  B7 0801               STAA    UDAY1
0A02  86 32                 LDAA    #$32
0A04  B7 0802               STAA    TDAY1
0A07  39                    RTS
                    *                       MONTHS THAT HAVE 30 DAYS ARE
                    *                       APRIL, JUNE, SEPT, NOV
0A08  86 31         M030    LDAA    #$31
0A0A  B7 0801               STAA    UDAY1
0A0D  86 33                 LDAA    #$33
0A0F  B7 0802               STAA    TDAY1
0A12  39                    RTS
0A13                END
```

sembled, depending on the nature of the change.

As previously stated, the interrupt frequency can be changed to virtually any value. For example, if the 60 Hz timebase is reduced to 15 Hz, simply change the operand value of the CMP A instruction at $0909 from 60 ($3C) to 15 ($0F).

The program requires slightly over 1/2K of memory, and execution starts at $0850. Reassembling the program at $0000 would improve the efficiency, since the 6800 could then use direct addressing. This has an advantage since it would decrease the program's overhead time, as well as reduce the amount of memory required. ■

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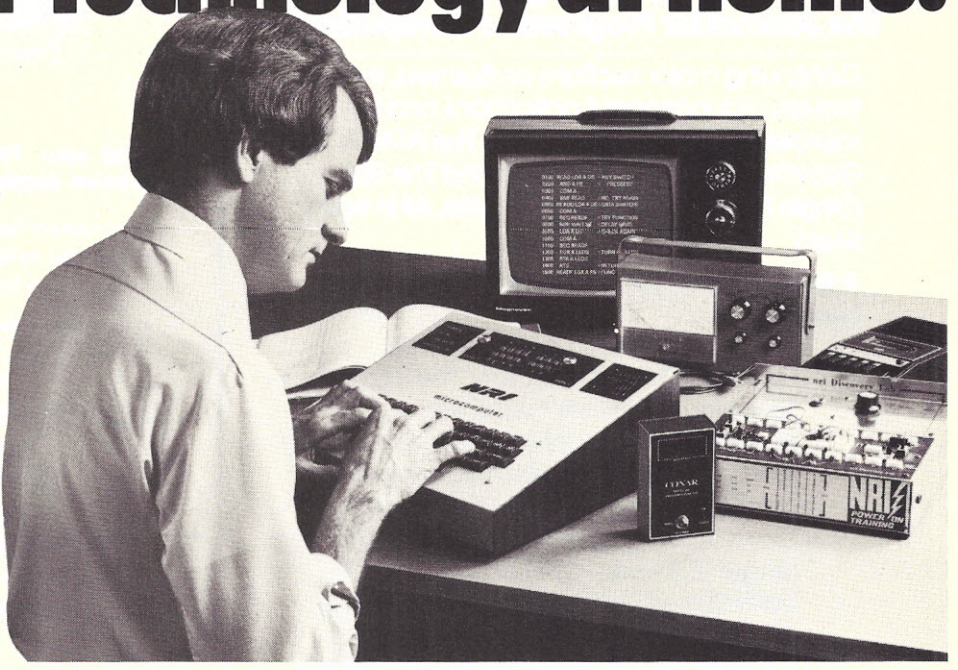

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Reader Service—see page 227

Converting a Bargain TV to a Video Monitor

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It is common knowledge in the microcomputer world that television sets can be used for video monitors, and many of us are doing just that. I want to share my experience in converting a relatively inexpensive, 12-inch black and white television set to direct video entry.

I bought a Westport Model RP-205BN television on sale at Woolco for $69. It is all solid state (except for the picture tube, of course), operates from 12 V dc as well as 110 V ac and has a power transformer that isolates the whole unit electrically from the ac line, considerably reducing chance of shock. There is also an earphone jack that can be used as the entry point for the video signal from your video board/generator.

Last, and very important, is that with the operating instructions comes a separate sheet containing the complete schematic diagram of the TV! This is an unusual addition for a consumer electronic item. It is a deal hard to beat for the price, especially in comparison with the $149 monitors I see advertised in the catalogs.

The Conversion Details

My guide for making the conversion was Don Lancaster's *The Cheap Video Cookbook*. It just so happens that the video amplifier circuitry shown by Lancaster on page 149 of his book corresponds *exactly* to the video amplifier circuitry in the RP-205BN, including component numbers (e.g., Q201, the video amplifier and R113). It is as if Lancaster was looking at the schematic of the RP-205BN when he wrote the book! For those of us who are not used to poking our way into TVs, it is reassuring to find such corresponding information to use as a guide.

The most important modification—lifting Q201's base lead from the printed circuit board—could hardly be easier. All the leads of the transistor are labeled on the top side of the PC board (the transistor itself is easily found because most of the components on the board are clearly labeled). You don't have to do lots of detective work on pin-outs and let yourself be vulnerable to what I call Murphy's mix-ups.

I used some Solder-Wick to remove the solder from the printed circuit pad to which the base lead of Q201 was joined. I then gently pulled the lead out of its hole in the board with a pair of long-nose pliers, bending the lead slightly at the same time and pushing the transistor away from the hole also to ease the task. The most difficult part was over! (If you are nimble-fingered and have small hands, you can dispense with the desoldering and simply cut Q201's base lead above the board; however, that would leave a short lead to which you could connect the miniature coaxial cable.)

Don Lancaster describes the general procedure well enough. I will concentrate on the specifics for this set. Connecting the coax (I used RG-174U) to the video detector output is especially easy on this set because there is a test point prong, TP12, so labeled both in Lancaster's book and on the TV's schematic and located right next to Q201!

This test point in the original set is connected directly to the base lead of Q201. It couldn't have been more conveniently situated either in the circuit or on the PC board. It becomes for us the terminal of the TV's video detector output on the PC board. It was simple, then, to solder the center conductor of the coax going to the video detector output to this test point prong and the shield of the cable is to the nearby tin shield of the TV's I.F. section.

The other cable going to the ex-earphone jack is connected to Q201. The center conductor is soldered to the base lead of Q201, and the coax shield can be soldered to the same tin shield as was that of the other piece of coax.

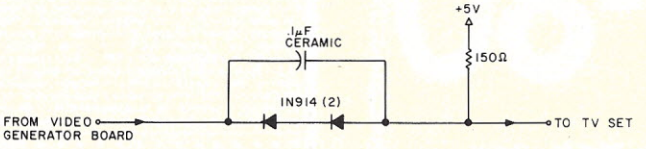

Fig. 1. Video output level modification.

Actually, instead of using the earphone jack for the video input, I installed an extra jack next to it toward the back of the set; it was easier to do that than to remove the wires and solder from the earphone jack. They are small themselves, and the space is a bit cramped. This completed the chief modification.

Lancaster recommends removing the 4.5 MHz sound trap of the TV to improve the video bandwidth and transient response. On this Westport TV, the 4.5 MHz trap is a series resonant circuit made up of C201 and L201. To disable the trap I cut with an X-acto knife the PC board foil connecting C201 and L201. Across that cut I connected a miniature SPST switch by which I can reinsert the sound trap if ever I want to use the set again as a TV. I mounted the switch on the bottom of the TV between a couple of the ventilation slots in the plastic case.

After all that, I have been able to observe only a slight difference in display quality between the two switch positions. You could probably do without the modification.

I am using the Xitex SCT-100 video board for my display. Its video output level is 1.5 V peak-to-peak. This is not quite enough to drive the TV's video amplifier, so I had to change this level to match that required by the video amplifier. This modification is simple with Lancaster's book as a guide (see p. 159 of *The Cheap Video Cookbook*. For a slightly longer treatment of the problem, see

Lancaster's *TV Typewriter Cookbook*, pp. 189-190).

I used two 1N914 silicon diodes in series as shown in Fig. 1. Two were enough. I mounted the diodes, capacitor and resistor close to the Xitex board in its enclosure. Finally, per Lancaster's recommendation (p. 150), I removed the lightning protection resistor (in this set it was 1 megohm) mounted near the antenna terminals.

Final Adjustments

On completing these modifications I hooked up the Xitex board to the TV via the new jack I installed and filled the screen with characters. The Xitex board generates 16 lines of 64 characters each. This number of characters pushes the screen's capacity to its limits. I found that the whole display was off center to the right and that the characters were not exactly vertical but leaning to the left slightly.

I went to the horizontal hold adjustment, a variable inductor next to the vertical hold on the back of the set. (I had the back of the TV off since the holes in the case were not well aligned with the adjustments' slots.) The horizontal hold adjustment requires a square tuning tool to fit the slug, which I did not have.

With a small piece of printed circuit fiberglass filed down to size at one end, I adjusted the horizontal hold until the characters were all oriented straight up and down with no slant. This, however, shifted the whole body of characters over to the right so much that several columns were completely off the screen. I remedied this by moving one of the ring magnets on the CRT's neck (Don Lancaster shows them in Fig. 3-33., p. 152, and has a note about them on page 153). I moved the one whose tab is toward the white flyback transformer.

When I moved the tab initially, the other ring magnet moved with it; they were lightly stuck together. I held that one and moved the first one. In this way, I was able to shift the whole body of characters back to the center of the screen. The vertical orientation of the characters was preserved. The display looks OK.

These easy-to-make changes and adjustments in a commonly available, inexpensive television set have given me a good quality video monitor for my microcomputer. I would encourage anyone beginning in microcomputing or anyone upgrading his or her system by adding a video display to do it in this way. I'll be happy to try to answer any questions you might have, but please include an SASE. ■

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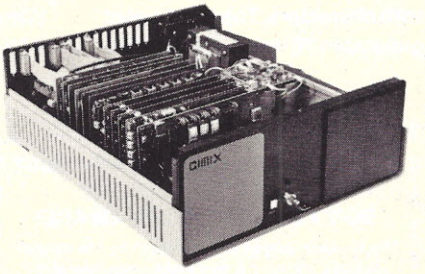

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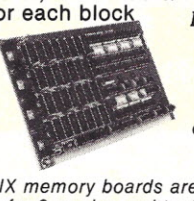

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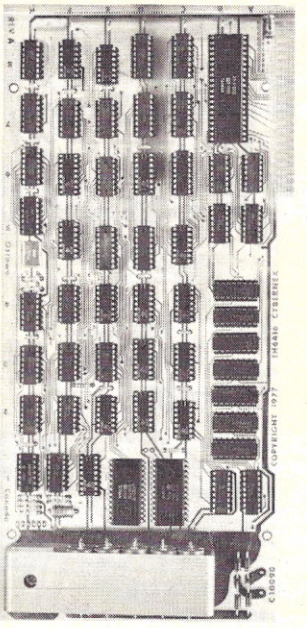

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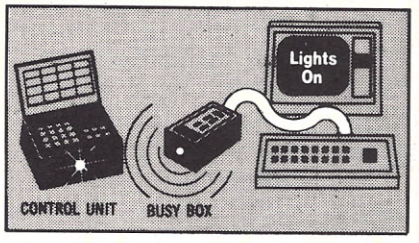

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Load Your SWTP at 4800 + Baud

The author tried JPC Products' cassette interface and found it reliable to 9600 baud.

Jerry L. Hunt
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Springfield VA 22150

While your Kansas City Standard tape is loading, do you:

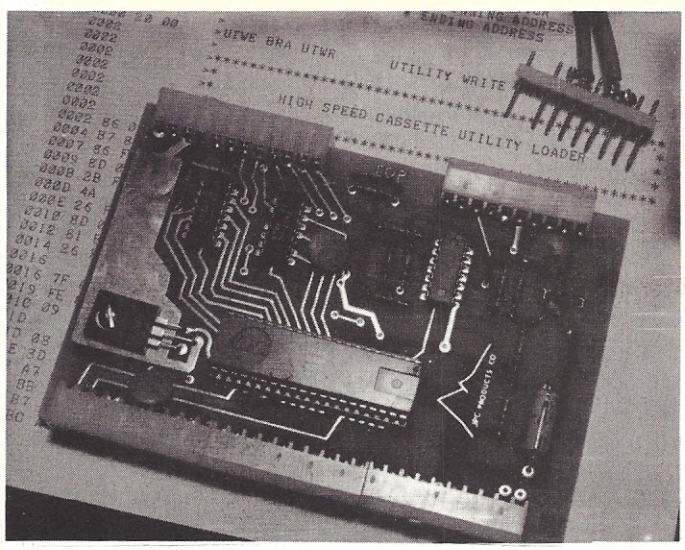
A. Tap your fingers impatiently?
B. Yell at your kids and dog?
C. Rebuild your keyboard?
D. Take a correspondence course in brain surgery?

If you would like to spend less time fussin' and fumin' and more time computin', read on.

Since I've had a computer, I've spent several man-days waiting for my KC tapes to load. This has become limiting, as well as irritating. After becoming fed up, I started looking for a medium with a bit more speed. My search first took me to the obvious devices such as digital tape decks and floppy disks. These gadgets have two common characteristics: quickness and expense. The first characteristic is very attractive, but the second is not as appealing.

One evening, while waiting for a tape to load and browsing through a *Microcomputing* magazine, I noticed an ad from JPC Products Co., PO Box 5615, Albuquerque NM 87185, for a $49.95, 4800 baud tape interface bit that plugged into an SWTP I/O port. I looked at the remaining 10 minutes of KC tape still to be loaded and ordered the interface!

About three weeks (and several more hours of KC tape loading) later, the package was delivered. It consisted of the hardware and a comprehensive hardware/software manual. The kit went together with ease. Hookup was equally easy and consisted of soldering two shielded cables to the connector and plugging them into a suitable cassette device.



TC-3 Hi-Speed Cassette Interface.

Building Up Speed

Due to the high speed of the data flow—up to 9600 baud—two factors are important. High-quality tape is essential, as is a high-quality cassette machine. The manufacturer recommends only top of the line, low-noise tapes and provides a recommendation list of cassette recorders and decks. Basically, a good stereo tape deck and tapes should be used.

My way of providing these was to remove the stereo tape deck and tapes from my component stereo system. The deck has two features that are useful in this application: an accurate tape counter and vu meters (output meters). Also helpful were the record level and output level controls.

The software documentation provided included two programs: one for high-speed read and write and one for KC read. This type of interface is versatile as well as fast, since it functions almost entirely through software. Thus, it can be programmed for nearly any format, current or future! The data transfer rate is controlled by software constants and the computer's clock. A short program is included to determine your SWTP computer's clock rate, and constants are furnished so that the baud rate is variable up to 9600!

The manufacturer recommends the baud rate be set at 2400 for system setup, and once any bugs are exterminated, the rate is set to the advertised 4800 baud. After all the time I had sat listening to the whirring of my cassette recorder, this sounded like the speed of light! However, I also believed if 4800 was good, 9600 would be great!

I inserted the proper constants for 9600 baud in the program and, much to my amazement, it worked! JPC Products only guaranteed 4800 baud, but mine has been playing great at 9600.

About one out of 20 loads requires reloading, due to a slipped byte somewhere, but when the system indicates a good load, I *never* find an error. This system is much more reliable than my KC system.

The one factor I found somewhat uninspiring was the necessity to boot in the read software via our crawling friend, a KC tape. It takes only about 30 seconds to load; however, I was spoiled.

My SWTP system incorporates an MPA2 board, which will accommodate 8K of EPROM,

017	ED. AS.	032	0000 IFFF	0100
Counter Start	Program Name	Counter End	Beginning Address Ending Address	Program Entry Address

Example 1.

and since the high-speed software is relocatable, I burned a 2716 with it. Loading 8K now takes only typing JC002 and waiting only 12 seconds! It takes only about 16 seconds at 4800 baud, probably due to software overhead time, which is not affected by the changeable constants.

File Search Program

I now had a system almost as fast as a disk, except for the file search capabilities. I work around this with a written listing, the footage counter and the output meters. My listing for a program is shown in Example 1.

I first set the memory locations MA002 through MA005, with the beginning and ending addresses I wish the program loaded into. You can put the program anywhere, unlike KC Standard tapes.

Next, I fast-forward or rewind the tape to one count prior to the start point (16 for this program). I then type JC002, press play on the deck and monitor the output meters for data output. At completion of a good load, the system returns directly to monitor control. If there is an error in the byte count read versus the byte count set in A002-5, a register dump will print prior to return to monitor. Total time from system start-up to operation in 8K is about 40 seconds. Writing to tape is done in the same manner with the write program.

I also have the KC loader in ROM, but I seldom use it since I have left the AC-30 and recorder on-line to load commercially purchased BASIC tapes. I'm hoping the company will give us some software to patch their operating system into popular BASICs. If that happens, would anyone like a good deal on an AC-30 and a very tired cassette recorder?

I'm currently working up software that will allow me to type in addresses more conveniently, use one-letter commands for control and allow one-letter load-run commands.

As I mentioned earlier, good tapes are essential. I have been using Radio-Shack-certified data tapes with excellent success. I have also used top-of-the-line, high-quality tapes from various manufacturers with good success, but anything less doesn't work! I like the Radio Shack tapes also for their 20 minute length. That's about 300K bytes including inter-program spaces! An additional feature of the interface (frosting on the cake) is a fully buffered 8 bit parallel output port.

Conclusion

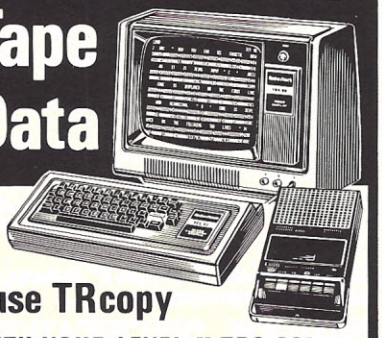
I am immensely pleased with this system. I recommend it without reservation as the best buy in town for fast, economical off-line storage. My system cost me only $49.95 for the interface. If you need a good tape deck, add about $80 to that. So for less than $150 you can have a 4800 baud system capable of storing one megabyte (60-minute tape).

I have no association with JPC Products, except for admiring their product. I haven't even communicated with them, since the interface and software operate flawlessly.

I have also just discovered that JPC is offering software for a cassette operating system, file handling and basic patches. My prayer is answered for about $27 on cassette! ■

✓ Reader Service—see page 227

See and Copy Tape Data



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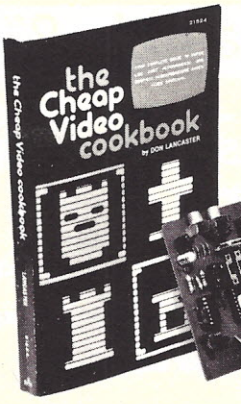

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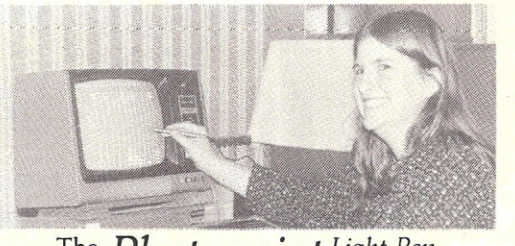

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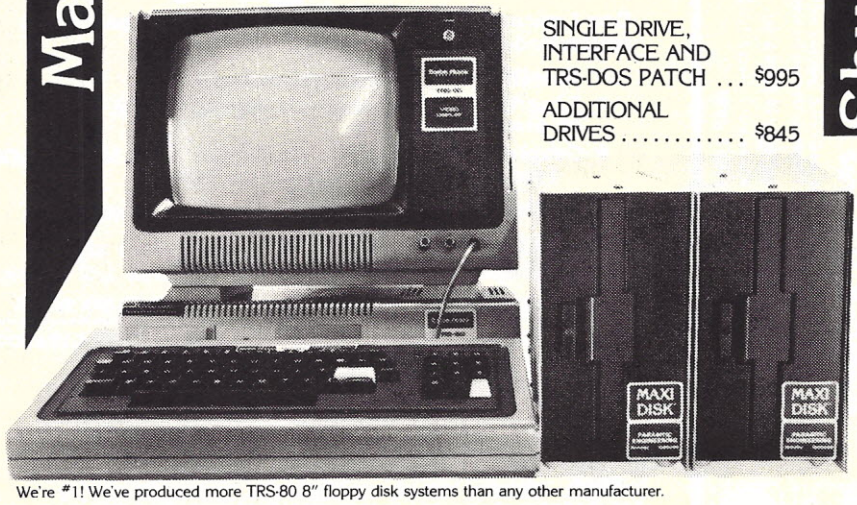

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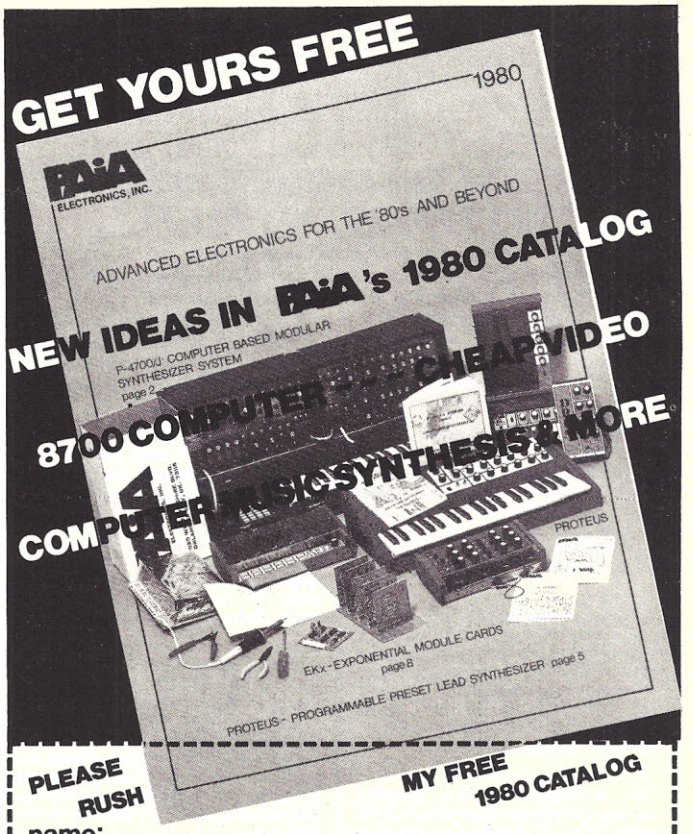

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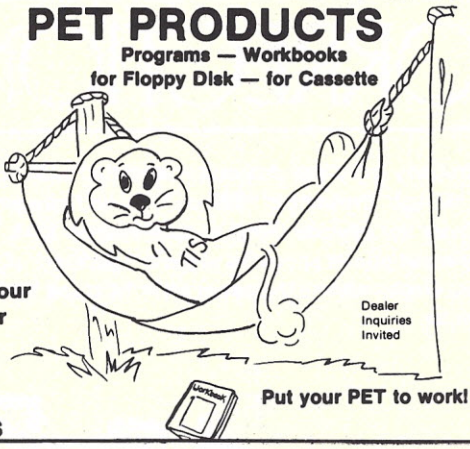

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For Sale: OSI C1P 8K. Includes extended monitor, editor/assembler and chess tapes. Moving to C4P. $399 or best offer. Good condition. Barry Beal, RFD #1 Box 160, Machias ME 04654.

CORRECTIONS

The property gain/loss program associated with "Boy, Did I Make a Killing!" (November 1979, p. 112) has three small omissions. There are obvious blank spaces in lines 1340, 1450 and 1460. My smart printer should have put a "less than" sign in 1340 and an up arrow (raise to the power of) in 1450 and 1460.—Frank J. Derfler, Jr.

The −12 volt rail in Fig. 1 of "An Inexpensive and Easy EPROM Board" (December 1979, p. 62) should be a −5 volt rail.

In my article, "The Apple Goes to Market" (November 1979, pp. 70–76), there is an error in line 5110, Listing 5. In order to properly update the array, line 5110 *should* read:

```
5110  FOR I = Y TO X STEP −1: A(I) = A(I − 1): NEXT: X = X − 1: A(X) = B
```

In the article, X and Y were transposed, causing improper decrementing of the array. Sorry for any inconvenience this may have caused. Thanks to George Culberson, W7CBU, who called from Utah to point this out.—Leslie R. Schmeltz.

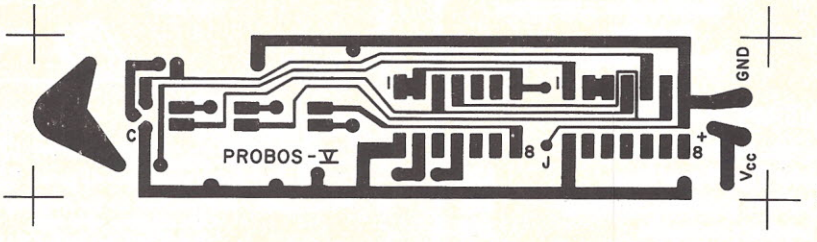

Fig. 3 of "Probos V."

Fig. 2 of "Probos V" (October 1979, p. 78) should show pin 3 of IC2 connected to pin 3 of IC1, and pin 6 of IC2 connected to pin 4 of IC1. It doesn't matter if the logic probe is built directly from the published schematic, but the corrected version will match up more closely to the printed circuit pattern. In addition, the anode of LED 3 (pulse indicator) should be shown connected to pin 8 of IC1. Fig. 3 also contains an error; see the corrected figure here.

The address of Statewide Mortgage Corp. (November 1979, p. 8) should be PO Box 660, El Cerrito CA 94530.

The following changes should be made to the "Inventory" program in the September 1979 issue. Also, the Sort subroutine changes should be made to the version that uses the machine-language sort routine.

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```
REPLACE  LINES 720 THRU 770 WITH THE FOLLOWING:

720 READ #0 %(T-1)*64+5,A3$
730 WRITE #0 %(R-1)*64+5,A3$,NOENDMARK
740 READ #0 %(T-2)*64+5,A3$
750 WRITE #0 %(T-2)*64+5,A3$
```

Main program changes.

```
F ROM: 1 260 READ #0 %(P(I)-1)*64+5,P$\!#0,P(I),TAB(5),P$\NEXT\CLOSE #0

T O: 1 260 READ #0 %(P(I)-1)*64+5,A3$\!#0,P(I),TAB(5),A3$\NEXT\CLOSE #0
```

Changes to "Inventory."

Sort subroutine changes.

```
F ROM: 4 30 P3=P3+1\!P3\IF P<=0 THEN 530 ELSE IF A$<>"N" THEN 120 ELSE 600

T O: 4 30 P3=P3+1\!P3\IF P<=0 THEN 525 ELSE IF A$<>"N" THEN 120 ELSE 600
```

```
ADD THE FOLLOWING TWO LINES

525 OPEN #0,"POINT"\FOR I=1 TO Y\WRITE #0,P(I,1)\NEXT
526 CLOSE #0
```

```
F ROM: 1 40 FOR I=B TO N+B-1\K=(A1-I1)\I1=I1+1

T O: 1 40 FOR I=B TO N+B-1\K=(A1-I1)\I1=I1+1\IF I>ETHENEXIT180
```

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Hex and ASCII

Do it with an ASCII keyboard.

Several months ago I set out to improve my acquaintance (then very limited) with microprocessors and to learn the mechanics of CPU interface. Experience being the best teacher, I elected to build from "scratch," designing and building as needed, rather than assembling any of the multitude of CPU kits currently available. This article is a natural evolution of that process and was put together in hopes that other fledglings might benefit from my experience.

An interface module capable of accepting the ASCII-coded outputs of a low-priced keyboard was needed (1) to convert certain of those codes into hexadecimal codes; (2) to reformat these codes to strobe out two characters in parallel; (3) to provide keyboard control of a CPU.

There is a great tendency in all of us (and I am equally guilty as the rest) to approach such a design problem from a "new and exotic" viewpoint. However, after the first pangs of exoticism had passed and I had returned to this earth, I was able to work out a solution using commonly available components without waiting for the postman to deliver that one critical item six weeks hence . . . postmarked Timbuktu. This little jewel will meet all the requirements criteria at a price that will astound you.

Overview

To begin with, examine the keyboard output codes in Table 1. Note that the four lower-order bits for keys 0 and 1 through 9 are identical for both ASCII and hex but that ASCII recycles bits 1 through 4 starting at alpha character "A." Since we wish to use alpha characters A through F in hexadecimal, we must convert that to provide the essential hexadecimal codes in Table 1. Now examine the required versus available codes for alpha characters A through F in Table 1 again and note that adding the binary weight of 1001 to each character should provide the needed conversion to hex.

Keyboard Code Formats (Lower Four Bits Only)

KEY	HEX	ASCII
0	0000	0000
1	0001	0001
2	0010	0010
3	0011	0011
4	0100	0100
5	0101	0101
6	0110	0110
7	0111	0111
8	1000	1000
9	1001	1001
A	1010	0001
B	1011	0010
C	1100	0011
D	1101	0100
E	1110	0101
F	1111	0110

Table 1. Keyboard output codes.

We have now established design criteria for the primary function of this interface — "pass numeric lower-order bits unaltered but modify alpha character lower-order bits by adding nine." Establishing this criteria brings out one more requirement — the ability to discriminate between alpha and numeric characters. Examine the codes in Table 2 and you will see that this discrimination can be accomplished by bits 2^4 through 2^6. All numerics have a 011 code for these bits while the alpha characters of interest carry a 100 coding in those same bits. Now, let's go to Fig. 1 to apply what we have found.

The Circuit

In Fig. 1, the two hex inverters IC1 and IC2 provide active low outputs for ASCII codes 2^0 through 2^6, an E code and the keyboard strobe. These inverters can be eliminated if your particular keyboard can provide both true and false outputs for each of the required codes. Remember, saving two chips here requires that the number of conductors in the connecting cable be increased and that some buffering be lost at the conversion module end of the cable — a false economy!

IC3 examines bits 2^4 through 2^6. By using the false levels for 2^4 and 2^5, we establish coincidence for a low output at pin 12 for hexadecimal codes A through F. This output is inverted and fed as a mode control line to IC4 and IC6. A high on this line means CONVERT; a low prohibits conversion.

The necessary conversion is accomplished (as we determined earlier) by adding 9 to the alpha characters. We could utilize a four-bit adder or a PROM. However, a very low-priced chip (e.g., 7486 exclusive OR) can accomplish the same conversion if aided by a couple of AND gates and inverters.

The first step in the conversion is to invert 2^3 during alpha characters. This is readily accomplished by feeding the mode control line to pin 2 of the 7486. Look at Fig. 1. You will see that any level at XOR pin 12 will be inverted only when pin 13 is high. Thus, we add 8 only during characters other than numeric. Adding 1 to the lower-order bit is more complicated because "carries" must be considered.

It is not the purpose of this article to review the basics of binary addition, so please bear with me when I say you must invert 2^1 if 2^0 goes to a low as a result of addition. Assuming that we

do have a high mode line, pin 3 carries 2^0 inverted. This signal is, in turn, inverted by a segment of IC2 and fed to an AND gate segment of IC6 where it is passed only during alpha characters (Mode Control input to pin 9). The output of this gate, pin 8, is fed to the 2^1 segment of the XOR, IC4, where it, in turn, causes inversion of that binary bit. This method of addition and carry is rippled up through bits 2^0, 2^1 and 2^2 to accomplish an add 1 for these bits.

This ripple "add and carry" method works great until you get to alpha character D. At this point our "cheapy" method blows up and senses a false inversion on bit 2^1 of the output causing bit 2^2 to be inverted, with the result of D showing an output code of 1001 or the equivalent of a numeric 9.

The first two segments of IC1 and NOR gate IC5 are utilized to inhibit AND gate IC6-A on character D, thus preserving our ripple and carry approach. False inputs of 2^0 and 2^1 are fed to IC5, causing it to go low on the output only during character D (examine Table 1 once again, only the D of alpha characters A-F has lows in 2^0 and 2^1, simultaneously). This low on IC5 is what inhibits the conversion during character D. Pins 3, 6, 8 and 11 of the XOR carry the hex code outputs.

Our next step is to reformat these hex codes to strobe

				E	0	0	0	0	0	0	0	0	1
				2^6	0	0	0	0	1	1	1	1	0
				2^5	0	0	1	1	0	0	1	1	0
2^3	2^2	2^1	2^0	2^4	0	1	0	1	0	1	0	1	0
0	0	0	0		NUL		SP	0	@	P			BRK
0	0	0	1		SOH		!	1	A	Q			CTL
0	0	1	0		STX		"	2	B	R			CLR
0	0	1	1		ETX		#	3	C	S			HIS
0	1	0	0		EOT		$	4	D	T			LB
0	1	0	1		ENQ		%	5	E	U			RB
0	1	1	0		ACK		&	6	F	V			
0	1	1	1		BEL		'	7	G	W			
1	0	0	0		BS		(	8	H	X			
1	0	0	1		TAB		)	9	I	Y			
1	0	1	0		LF		*	:	J	Z			
1	0	1	1		VT		+	;	K	[			
1	1	0	0		FF		,	<	L	\			
1	1	0	1		CR		-	=	M	]			
1	1	1	0		SO		.	>	N	Λ	ESC		
1	1	1	1		SI		/	?	O			DEL	

Table 2. ASCII codes for Archer keyboard.

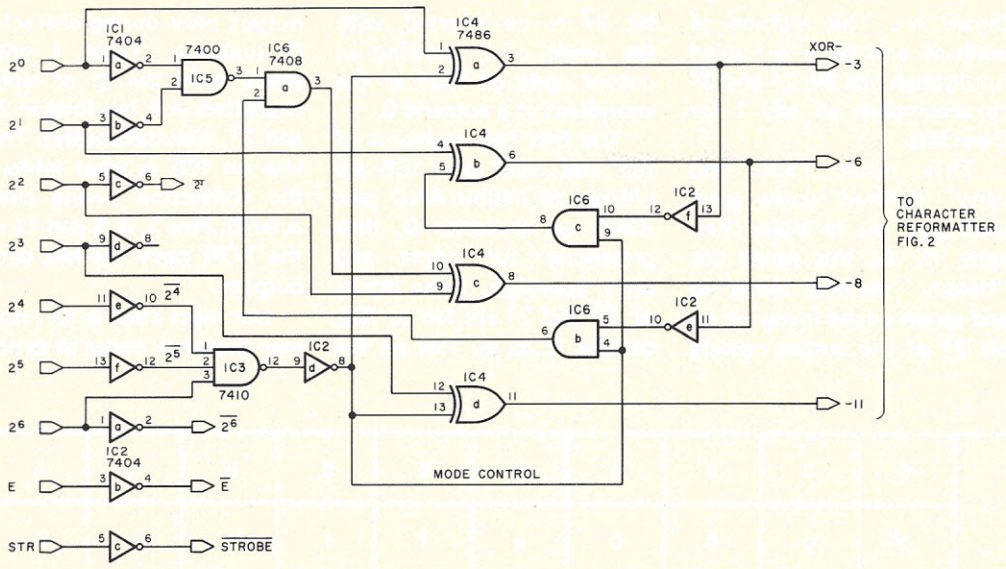

Fig. 1. ASCII/hex converter.

two characters out in parallel, meeting the 8-bit bus requirement of many of the popular CPUs. Fig. 2 is a single function diagram of the "shape-up and ship-out" reformatter. The requirement is to recognize when the operator wants to output a hex-formatted code. This recognition is accomplished by IC1, an 8-bit NAND gate. By feeding this gate appropriate true and false (2^2 and 2^6) ASCII outputs 2^0 through 2^6, a low is achieved from a semicolon key.

IC4 is a 5-bit shift register. The inverted output of the recognition chip (pin 2, IC2) is combined with the keyboard strobe in AND gate IC3A to provide a load signal for the shift register, loading a 10000 sequence upon receipt of a ; signal. The clock for the shift register is provided at pin 6 of IC3B. This clock is inhibited while the keyboard is active with a semicolon. A four-bit latch is activated by the first parallel output bit (7496-15) and, therefore, loads the first hex character appearing on lines 2^0 through 2^3 of the code converter as shown in Fig. 1.

When the keyboard strobe appears after keying in the first hex character, the shift register shifts to the right to output a parallel code 01000. This code latches the first hex word in IC5 and holds same as an interim memory. Outputs of the 4-bit latch are routed through a four-channel bilateral switch (IC6) to the CPU data bus D^4 through D^7. The four lines 2^0 through 2^3 from the code converter are also routed through a four-channel bilateral switch (IC7) to CPU data bus bits D^0 through D^3.

When the second hex character is entered from the keyboard, it is inhibited from entering the 4-bit latch due to the previous shifted pattern of the shift register. The shift register, moving once more to the right with the keyboard strobe, enables AND gate IC3-C via pin 9, allowing the keyboard strobe to pass through this AND gate and enabling the CPU to strobe the two characters held at the bilateral gates (IC6, 7) onto the CPU data bus in parallel. These bilateral gates also appear as Tri-state outputs to the data bus, effectively preventing the loading of the bus except during the strobe pulse from the CPU when either 1 or 0 is presented to each of the 8 CPU data lines.

So far we have met two of our initial three objectives: We have provided code conversion, ASCII to hex, and reformatted to strobe out two hex characters in parallel to the CPU. It should be noted that while this process is being followed, the keyboard simultaneously provides ASCII-coded output *one character at a time* for character presentation on a TVT. The diagram for CPU control is presented in Fig. 3.

External Keyboard Control

In Fig. 3, IC3 and IC4 are each a control pair comprising AND gates cross-connected to latch in commands from a decoder, IC2.

The Archer keyboard used in this project presents an E bit on 2^7 output. This E bit appears for six non-ASCII-coded keys: BREAK, CTRL, CLEAR, HERE IS and two unmarked, uncommitted keys. The 7442 decoder (IC2) in Fig. 3 functions as a recognition circuit for these keys when presented with true signals from 2^0 through 2^2 plus a strobed $\overline{E}_S$ input. NAND gate IC1 provides the strobed E signal and also serves as an inverter to provide the necessary active low input to IC2. The six decoded

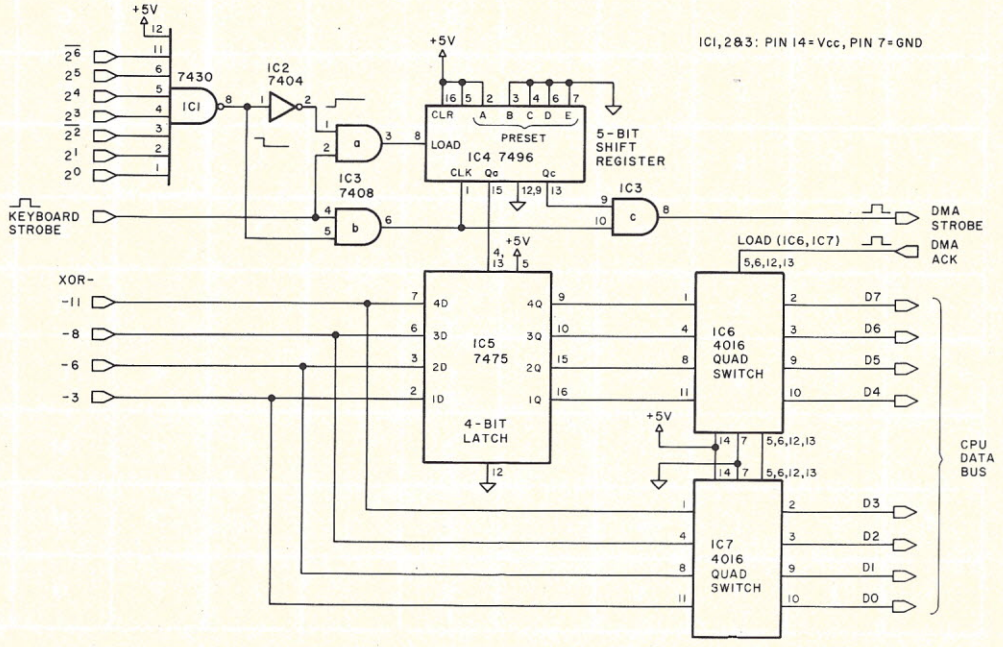

Fig. 2. Single function diagram of the character reformatter.

outputs appear as active low signals for BREAK, CTRL, CLEAR, HERE IS, LEFT BLANK and RIGHT BLANK.

When directed to the appropriate inputs of IC3 and IC4 as shown in Fig. 3, four keys have the ability to force latched outputs at output pins 1A, 1B. BREAK will cause a low at pin 1A and a high at pin 1B. This is WAIT logic for an RCA COSMAC CPU with which this interface module is now working. CLEAR causes a low on pin 1 of IC4 and a high at pin 1 of IC3. This is CLEAR logic for the same CPU. RUN provides highs at both output terminals, while HERE IS provides a LOAD function of two lows at the same terminals.

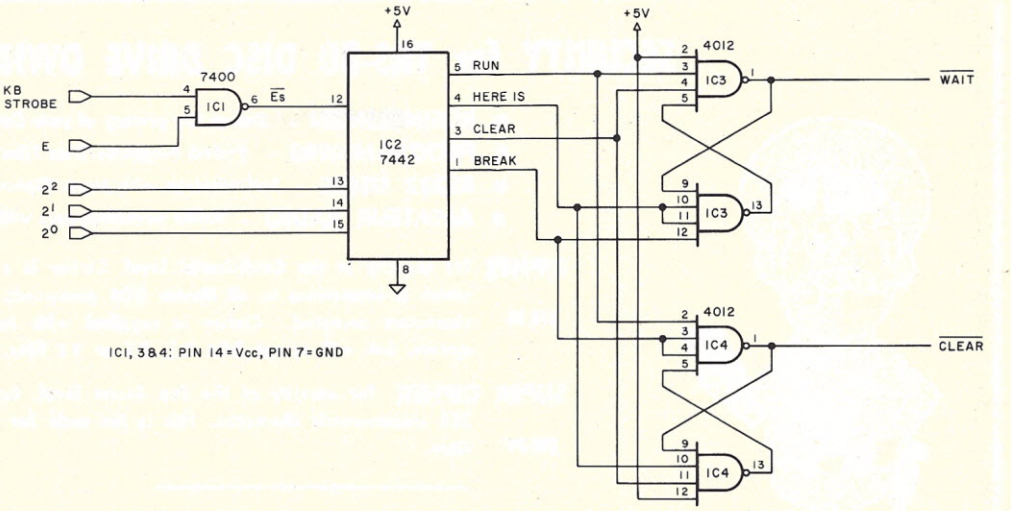

Fig. 3. CPU control.

Summary

This concludes the description of the interface module and its functions. Again, it is not exotic in form, but it does provide in a reliable manner three essential functions of code conversion, reformatting and CPU control. It can be constructed without real concern for critical layout of lead dress (the original was wire-wrapped on a Radio Shack prototype board) and all components are low cost and possibly available in your junk box.

In any event, the total chip complement costs under $5 at any of the several houses advertising in this magazine. The design is not without shortcomings. It does not provide for back-stepping in the case of erroneous entry, nor can it obviate illegal entry such as the keying in of shifted characters . . . but what can you expect for less than $5? Plans are currently underway to add back-spacing capability for program correction and rapid program step through for entry verification. The latter is considerably more useful to limited systems without CRT display than to those lucky people with TVT connections. ■

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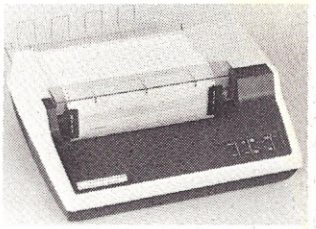

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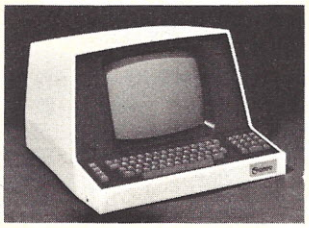

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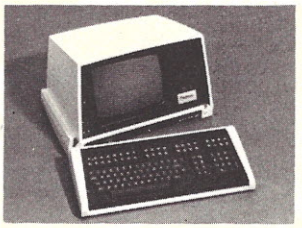

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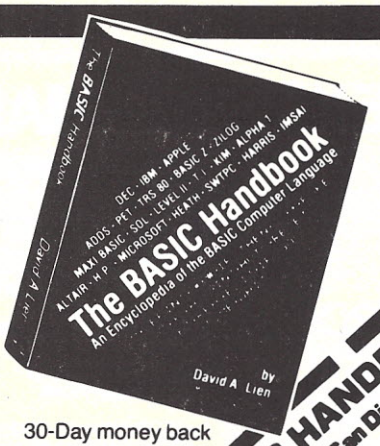

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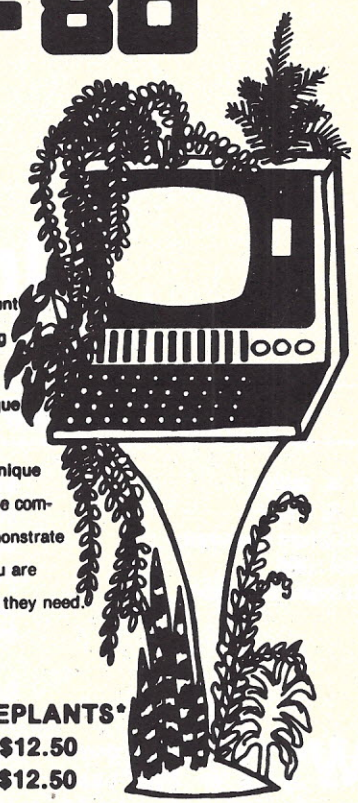

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Interrupting BASIC

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D. H. Willits
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NC State University
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We have been developing an 8080-based microprocessor system for data acquisition and environmental control in greenhouses used for energy research. The data acquisition function requires as many as 15 data points to be read periodically (some as often as once per minute) and the data processed for output at half-hour intervals. The control function requires certain points to be read and the information processed on 15 second cycles so that heaters, vent fans and cooling pads can be properly controlled. A further requirement is that the system be capable of responding to commands entered from the keyboard at any time.

Data acquisition and control functions can easily be handled with polling loops, but in this application the requirement for random access to the control and data acquisition program made polling cumbersome. Utilizing interrupts to initiate action seemed to provide the answer, but it also presented us with a problem. We want to program mostly in BASIC, rather than assembly language, but the BASIC interpreters available have no provisions for servicing interrupts.

This article discusses three approaches developed to overcome this problem: (1) handling the interrupt in assembly language with a return to the point of interrupt in the BASIC program; (2) handling the interrupt in BASIC with no return to the point of interrupt; (3) handling the interrupt in BASIC with a return to the point of interrupt in the BASIC program. Each approach has advantages and disadvantages that depend on the particular application.

The BASIC interpreter we used is Cromemco's 3K Control BASIC (CB), but all the techniques used should apply to other interpreters, provided you have access to the source listing for the interpreter. A fully commented source listing is easier to work with, but it can be done with just a listing from a disassembler if you're dedicated enough and are proficient at reading assembly language.

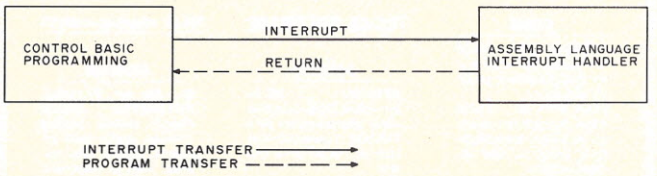


Fig. 1. Activity flow for handling interrupts in assembly language.

Handling Interrupts in Assembly Language

The simplest way to handle interrupts is to process them in an assembly-language subroutine with a return to the BASIC program that was executing at the time of interrupt. Table 1 shows the assembly language required, and Fig. 1 shows the activity flow between the CB programming and the interrupt handler. Our system has vectored interrupt capability so that eight separate interrupt signals can be handled, each causing transfer to one of eight different memory locations between %0000 and %003F. (The % symbol is used to designate hexadecimal numbers throughout the text. The exception is in the assembly listings, where hex numbers are suffixed with an H according to standard practice.)

An EI (enable interrupt) command must be executed before the microprocessor will recognize an interrupt, and a mask word is required to disable unwanted interrupts. These steps are included in the initialization routine 'INIT'.

We chose the interrupt that

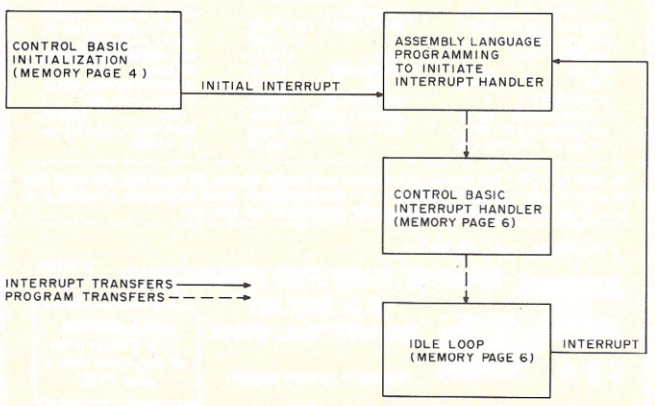


Fig. 2a. Activity flow for limited handling of interrupts in BASIC, Version I.

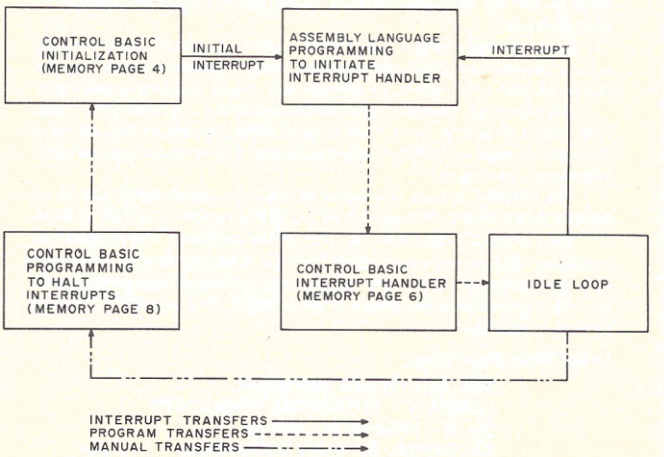


Fig. 2b. Activity flow for limited handling of interrupts in BASIC, Version II.

transfers control to location %0008 and masks the rest. The JMP instruction at %0008 transfers control to %0040 where the interrupt service (which can be any assembly-language routine) is executed. Control is then returned to the BASIC program at the point of interrupt.

Note that the status word and registers must be saved in order to reenter the interrupted program. Note also that the interrupt service includes an EI command because the microprocessor disables interrupts as soon as an interrupt is received. Initiation of interrupt service is done by typing a CALL %0060.

This approach is simple and effective, provided that the task to be performed during interrupt service does not require mathematical computation or extensive manipulation. It requires little knowledge of the interpreter itself, beyond knowing where the interrupt handler can be stored. CB does not use the first two pages of memory, so locations up to %01FF are available.

A way to use BASIC to manipulate data read during the interrupt is available when variables are stored at fixed locations. CB stores 52 variables denoted by letters A through Z and A0 through Z0 in the first 104 bytes of memory page 3 (%0200-%0267). The interrupt handler can be used to store data at these locations. A BASIC program could be used to test the contents to determine whether an interrupt had occurred. This is the procedure recommended by Mits for use with the Altair real-time clock.

Limited Interrupt Handling in BASIC

Handling interrupts in assembly language is fairly difficult if calculation or output is required. There are obvious advantages of programming in BASIC to handle these situations, but this necessarily requires more knowledge of the programming of the interpreter. This approach is a relatively limited one that has some practical applications.

Suppose the main program does essentially nothing until an interrupt occurs. The inter-

```
0008   C3 40 00          JMP INTR
0040   F5          INTR  PUSH PSW        /SAVE STATUS WORD AND REGISTER
0041   E5                PUSH H          /CONTENTS ON CB STACK.
0042   D5                PUSH D
0043   C5                PUSH B
                                         /PROCESS INTERRUPT: ANY ASSEMBLY
                                         /LANGUAGE PROGRAM CAN BE PLACED
       Interrupt Processing              /HERE.  THE SPACE NEED NOT BE
       goes here                         /RESTRICTIVE IF SUBROUTINES AND
                                         /JUMPS ARE USED.
005A   C1                POP B           /RESTORE REGISTER CONTENTS AND
005B   D1                POP D           /STATUS WORD.
005C   E1                POP H
005D   F1                POP PSW
005E   FB                EI              /ENABLE INTERRUPTS AND RETURN.
005F   C9                RET
0060   3E FD       INIT  MVI A,0FDH      /THIS SUBROUTINE INITIALIZES THE
0062   D3 0A             OUT 10          /INTERRUPTS: A MASK WORD IS OUTPUT
0064   FB                EI              /TO ELIMINATE UNWANTED INTERRUPTS
0065   C9                RET             /(NOTE: THE ACTUAL MASK WORD AND
                   PSW   EQU 6           /OUTPUT PORT ARE SYSTEM DEPENDENT.
                                         /CHECK YOUR SYSTEM MANUAL FOR
                                         /DETAILS).  ENABLE INTERRUPTS AND
                                         /RETURN.
```

Table 1. Assembly-language programming and machine code for handling interrupts.

```
                    (Memory Page 4)

 10  REM  INITIALIZATION
 20  REM  LOAD MACHINE CODE FOR INTERRUPT SERVICE ROUTINE, 'LOAD' (FIGURE 3)
 30  PUT(%0040) = %06, %07, %11, %69, %02, %21, %59, %00
 40  PUT(%0048) = %7E, %12, %13, %23, %05, %C2, %48, %00
 50  PUT(%0050) = %1B, %1B, %21, %00, %00, %FB, %C3, %42
 60  PUT(%0058) = %E4, %52, %55, %4E, %20, %36, %0D, %FF
 70  REM  LOAD MACHINE CODE FOR INITIALIZATION ROUTINE, 'INIT'
 80  PUT(%0060) = %3E, %FD, %D3, %0A, %FB, %C9
 90  REM  SET JUMP AT %0008
100  PUT(%0008) = %C3, %40, %00
110  REM  OTHER INITIALIZATION GOES HERE, IF ANY
120  REM  ENABLE INTERRUPTS BY CALLING 'INIT'
130  CALL %0060
140  STOP

                    (Memory Page 6)

 10  REM  INTERRUPT HANDLER
 20  REM  ANY PROCESSING GOES HERE
 30  REM  ENTER IDLE LOOP TO WAIT FOR NEXT INTERRUPT
 40  GOTO 40
 50  STOP
```

Table 2a. BASIC programming for limited interrupts, Version I.

```
                    (Memory Page 4)

 10  REM  INITIALIZATION
 20  REM  LOAD MACHINE CODE FOR INTERRUPT SERVICE ROUTINE ('LOAD') HERE
 30  REM  LOAD MACHINE CODE FOR INITIALIZATION ROUTINE ('INIT') HERE
 40  REM  SET JUMP AT %0008
 50  REM  OTHER INITIALIZATION GOES HERE, IF ANY
 60  REM  ENABLE INTERRUPTS BY CALLING 'INIT'
 70  STOP

                    (Memory Page 6)

 10  REM  INTERRUPT HANDLER
 20  REM  ANY PROCESSING GOES HERE
 30  REM  INTERPRETER RETURNS TO ITS OWN IDLE LOOP (NOT SHOWN) TO AWAIT INPUT
          FROM KEYBOARD

                    (Memory Page 8)

 10  REM  INTERRUPT HALT
 20  REM  LOAD ASSEMBLY LANGUAGE TO PERFORM HALT
 30  PUT(%0100) = %F3, %C9
 40  REM  CALL HALT ROUTINE
 50  CALL %0100
 60  STOP
```

Table 2b. BASIC programming for limited interrupts, Version II.

```
0008   C3 40 00          JMP LOAD
0040   06 07       LOAD  MVI B,7          /LOAD 'RUN 6' INTO INTERPRETER AND
0042   11 69 02          LXI D,0269H      /JUMP TO BASIC: PUT LENGTH OF STRING
0045   21 59 00          LXI H,STR        /(INCLUDING SPACES, CR, AND TRAILING
0048   7E            LP  MOV A,M          /FFH) INTO B, PUT COMMAND STRING
0049   12                STAX D           /LOCATION INTO DE, GET ASCII STRING
004A   13                INX D            /'RUN 6' AND STORE IN COMMAND STRING
004B   23                INX H            /LOCATION, ENABLE INTERRUPTS AND JUMP
004C   05                DCR B            /TO THE INTERPRETER AT LOCATION E442H.
004D   C2 48 00          JNZ LP
0050   1B                DCX D
0051   1B                DCX D
0052   21 00 00          LXI H,0000
0055   FB                EI
0056   C3 42 E4          JMP 0E442H
0059   52 55 4E    STR   ASC 'RUN 6'      /THIS IS THE ASCII STRING, 'RUN 6',
005C   20 36                              /FOLLOWED BY A CR AND AN FFH.
005E   0D FF              DW 0FFODH
0060   3E FD       INIT  MVI A,0FDH       /THIS SUBROUTINE INITIALIZES THE
0062   D3 0A             OUT 10           /INTERRUPTS: OUTPUT MASK WORD TO
0064   FB                EI               /ELIMINATE UNWANTED INTERRUPTS.
0065   C9                RET              /ENABLE INTERRUPTS AND RETURN.
```

Table 3. Assembly-language programming and machine code for limited interrupt service.

```
                    (Memory Page 4)

10  REM  INITIALIZATION
20  REM  LOAD MACHINE CODE FOR INTERRUPT SERVICE ROUTINES HERE IF DESIRED
30  REM  LOAD MACHINE CODE FOR INITIALIZATION ROUTINE ('INIT') HERE
40  REM  SET JUMP AT %0008
50  REM  OTHER INITIALIZATION GOES HERE, IF ANY
60  REM  ENABLE INTERRUPTS BY CALLING 'INIT'

                    (Memory Page 6)

10  REM  INTERRUPT HANDLER
20  REM  ANY PROCESSING GOES HERE, RETURN WHEN FINISHED BY CALLING 'REPL'
30  CALL %0096
```

Table 4. BASIC programming for full interrupt service.

rupt is serviced and then the program waits for the next interrupt. Provided that any interrupt can be completely serviced before the next one occurs, the main program will always be in an idle state at the time of interrupt, and it is not necessary to return to this point. This would be true, for example, for interrupts occurring on a regular schedule, such as clock pulses, but not true for random interrupts coming from the keyboard or from another device.

The BASIC program required is shown in Table 2a and the accompanying Fig. 2a. It consists of three main parts: (1) an initialization routine starting on memory page 4; (2) the interrupt handler starting on memory page 6; (3) the idle loop following the interrupt handler. The initialization routine is executed first by typing the command RUN. This stores the machine code for the assembly-language routines and performs any other initialization written in by the user. The last step is to execute the CALL %0060 command, which will enable the interrupts.

Since there is usually an interrupt request present when clock signals are being used for interrupting, execution of the EI command will initiate the interrupt service, which in turn transfers control to memory page 6. The idle loop is entered when the interrupt processing is finished.

A more sophisticated version of the same program can be written if we realize that the interpreter provides a loop of its own (while checking for keyboard input) that can take the place of the idle loop. Return to the interpreter loop is accomplished by omitting the STOP command from the routine stored on memory page 6. When Control BASIC encounters an end-of-file before a STOP is reached, the interpreter types an OK and a > and enters the loop waiting for input. This provides visual feedback to signify the end of interrupt processing and allows a short routine to be executed from the keyboard if desired (perhaps to disable interrupts).

Table 2b shows this version of the program with the idle loop at the end of the interrupt handler being eliminated and a routine, added on memory page 8, which loads a DI (disable interrupt) command and a RET at %0100 and then executes a CALL %0100 to stop the interrupts. The routine is executed by typing RUN 8 while the keyboard is active. This provides time to correct programming (during program development), execute a longer routine (say a memory dump) or perform any function desired by the user. The interrupt service is restored by typing a CALL %0060 command, which reenables the interrupts and starts the process again. The interaction among the various routines is shown in Figure 2b.

The execution of the routine on memory page 6 is made possible by a feature of Control BASIC that allows separate routines to be stored in different pages of memory, and a RUN command (followed by a page number) transfers control to the routine stored on that page. In this case, the interrupt service must create a RUN 6 and force the interpreter to execute the command as if it had been entered from the keyboard. In order to do that we had to determine how the interpreter handled those commands.

When a command is entered from the keyboard it is stored as a character string in memory locations starting at %0269. A trailing carriage return (CR) and %FF are added to denote the end of the string, and the interpreter jumps to location %E442 with the contents of the DE reg-

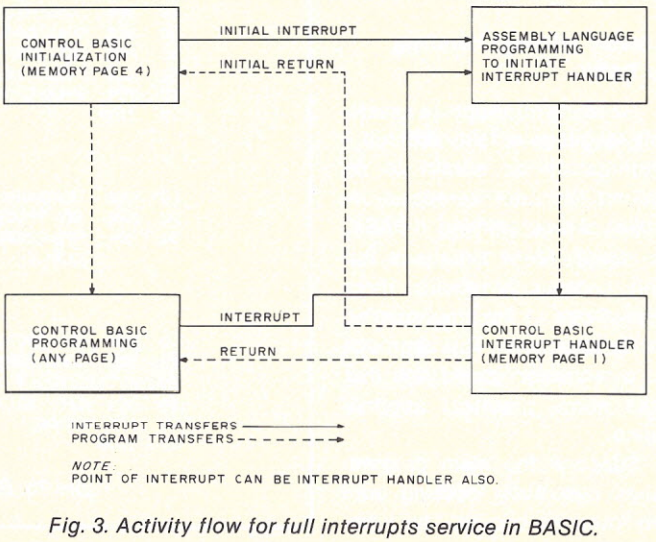


Fig. 3. Activity flow for full interrupts service in BASIC.

ister pointing to the CR and the HL register set to zero. The command is then executed by the interpreter. Table 3 shows an assembly-language simulation of this. Note that the character string RUN 6 is stored, and then a jump is executed to %E442.

This approach has the advantage of being able to process interrupts in BASIC with only a limited requirement for assembly-language programming. The disadvantage is that a program executing at the time of interrupt cannot be continued. This can severely limit what can be accomplished if the time between interrupts is short. Since our situation demanded a 15 second cycle, we had to keep trying.

Full Interrupt Handling in BASIC

Our final approach permits full interrupt processing in BASIC. A BASIC routine may be interrupted at any point (including within FOR/NEXT loops), and the interrupt is serviced in a BASIC subroutine. When the service is finished, execution continues at the point of interrupt. Furthermore, the basic interrupt service itself may be interrupted, which provides a great deal of flexibility in programming.

This is the most practical approach for our application, but it requires a more extensive knowledge of the interpreter and requires the most memory to execute. If we wish to interrupt a BASIC program, execute another BASIC program and then return to the point of interrupt, we must save the contents of all of the registers as in the previous example (eight bytes). We must also save all of the pertinent interpreter control variables (30 bytes) and that portion of the command string stored at %0269 that will be written over by the RUN 6 command and the trailing CR and %FF (eight bytes). Note that only seven bytes of the command string actually need to be saved if only a single digit-page number is used in the RUN command. However, it is recommended that the program be written to save eight bytes of the string since that will cover the highly probable situation where a double-digit page number might be used.

```
0008  C3 6E 00        JMP SAVE
006E  F5        SAVE  PUSH PSW      /SAVE STATUS WORD AND REGISTERS
006F  E5              PUSH H        /ON STACK.
0070  D5              PUSH D
0071  C5              PUSH B
0072  3E 0F           MVI A,0FH     /SAVE CONTROL VARIABLES:
0074  21 DE 03        LXI H,03DEH   /LOAD NO. OF BYTE PAIRS INTO A; PUT
0077  CD B7 00        CALL STORE    /DESTINATION INTO HL AND CALL STORE.
007A  3E 04           MVI A,04H     /SAVE PORTION OF COMMAND STRING:
007C  21 69 02        LXI H,0269H   /LOAD NO. OF BYTE PAIRS REQUIRED BY
007F  CD B7 00        CALL STORE    /RUN 6 (INCLUDING CR AND FFH) INTO A.
0082  2A 00 01        LHLD 0100H    /SAVE STACK POINTER ADDRESS: PUT
0085  EB              XCHG          /MEMORY POINTER IN DE; PUT OLD STACK
0086  21 00 00        LXI H,0000H   /POINTER ADDRESS INTO HL, MOVE TO DE
0089  39              DAD SP        /AND RETURN MEMORY POINTER TO HL.
008A  EB              XCHG          /STORE LOW BYTE OF OLD SP INTO
008B  73              MOV M,E       /MEMORY LOCATION ADDRESSED BY HL,
008C  23              INX H         /STORE HIGH BYTE IN HL + 1; INCREMENT
008D  72              MOV M,D       /HL TO POINT TO NEXT AVAILABLE
008E  23              INX H         /MEMORY LOCATION AND STORE AT 0100H.
008F  22 00 01        SHLD 0100H
0092  FB              EI            /ENABLE INTERRUPTS AND JUMP.
0093  C3 40 00        JMP LOAD
0096  2A 00 01  REPL  LHLD 0100H    /RETRIEVE STACK POINTER ADDRESS:
0099  2B              DCX H         /LOAD MEMORY POINTER FROM LOCATION
009A  56              MOV D,M       /0100H; MOVE HIGH BYTE TO D; MOVE
009B  2B              DCX H         /LOW BYTE TO E; STORE NEW MEMORY
009C  5E              MOV E,M       /POINTER; MOVE OLD SP ADDRESS
009D  22 00 01        SHLD 0100H    /(IN DE) TO HL; MOVE CURRENT SP
00A0  EB              XCHG          /TO OLD POSITION TO RECLAIM STORED
00A1  F9              SPHL          /INFORMATION.
00A2  21 70 02        LXI H,0270H   /RESTORE OLD COMMAND: LOAD COMMAND
00A5  3E 04           MVI A,04H     /STRING LOCATION INTO HL, NO. OF BYTE
00A7  CD C3 00        CALL RETRV    /PAIRS INTO A, CALL RETRV.
00AA  21 FB 03        LXI H,03FBH   /RESTORE OLD CONTROL VARIABLES: LOAD
00AD  3E 0F           MVI A,0FH     /ENDING LOCATION INTO HL; LOAD NO. OF
00AF  CD C3 00        CALL RETRV    /BYTE PAIRS INTO A, CALL RETRV.
00B2  C1              POP B         /RESTORE REGISTERS AND STATUS WORD.
00B3  D1              POP D
00B4  E1              POP H
00B5  F1              POP PSW
00B6  C9              RET
00B7  C1        STORE POP B         /THIS SUBROUTINE TAKES INFORMATION
00B8  5E        LOOP1 MOV E,M       /FROM MEMORY AND PUSHES IT ONTO THE
00B9  23              INX H         /CB STACK IN TWO-BYTE WORDS.  THE NO.
00BA  56              MOV D,M       /OF BYTE PAIRS PUSHED IS DETERMINED
00BB  D5              PUSH D        /BY A: POP THE RETURN ADDRESS AND
00BC  23              INX H         /SAVE IT IN BC, MOVE BYTE ADDRESSED
00BD  3D              DCR A         /BY HL INTO E, INCREMENT HL AND PUT
00BE  C2 B8 00        JNZ LOOP1     /SECOND BYTE INTO D; PUSH DE, INCREMENT
00C1  C5              PUSH B        /HL, DECREMENT A AND CHECK FOR ZERO;
00C2  C9              RET           /IF ZERO PUSH RETURN ADDRESS AND
                                    /RETURN.
00C3  C1        RETRV POP B         /THIS SUBROUTINE POPS TWO-BYTE WORDS
00C4  D1        LOOP3 POP D         /FROM CB STACK AND RETURNS THEM TO MEMORY.
00C5  72              MOV M,D       /NO. OF BYTE PAIRS IS DETERMINED BY A:
00C6  2B              DCX H         /SAVE RETURN ADDRESS IN BC, THEN POP
00C7  73              MOV M,E       /FIRST BYTE PAIR INTO DE; MOVE BYTE IN D
00C8  2B              DCX H         /TO MEMORY LOCATION ADDRESSED BY HL, DE-
00C9  3D              DCR A         /CREMENT HL AND MOVE BYTE IN E TO MEMORY;
00CA  C2 C4 00        JNZ LOOP3     /DECREMENT HL AND A; IF A IS ZERO, PUSH
00CD  C5              PUSH B        /RETURN ADDRESS AND RETURN.
00CE  C9              RET
0060  3E FD       INIT MVI A,0FDH   /THIS SUBROUTINE PERFORMS INITIALIZATION:
0062  D3 0A           OUT 10        /OUTPUT MASK WORD TO DISABLE UNWANTED
0064  21 00 01        LXI H,0100H   /INTERRUPTS (NOTE: THE ACTUAL MASK WORD
0067  36 02           MVI M,02H     /AND OUTPUT PORT ARE SYSTEM DEPENDENT.
0069  23              INX H         /CHECK YOUR SYSTEM MANUAL FOR DETAILS).
006A  36 01           MVI M,01H     /INITIALIZE MEMORY POINTER AT LOCATION
006C  FB              EI            /0100H, LOAD MEMORY POINTER, LOW BYTE
006D  C9              RET           /FIRST, THEN ENABLE INTERRUPTS AND
                PSW   EQU 6         /RETURN.
                SP    EQU 6
```

Table 5. Assembly-language programming and machine code for full interrupt service

The most convenient way to store the information to be saved is to use the CB stack pointer and push the information onto the stack. This will limit the number of times that an interrupt service can itself be interrupted, since 46 bytes of information must be saved, yet only 200 bytes of stack space are provided by CB. However, if the interrupt service does not include a lot of nested CALLs or GOSUBs, the limitation is not a problem.

The BASIC programming necessary to service interrupts is shown in Table 4. The diagram in Fig. 3 shows the relationship between the BASIC programming and the assembly-language programming shown in Table 5. The program on memory page 4 can be anything, including a routine to load the machine code as in the previous

example. The sequence is started by executing a call to the subroutine 'INIT', shown in Table 5, which enables the interrupts and initializes the memory pointer, which is discussed in the next paragraph (in this case, 'INIT' is located at %0060). The interrupt handler on memory page 6 must end with a call to the subroutine 'REPL', also shown in Table 5, which in this example is located at %0096. Anything after the CALL %0096 will not be executed since the subroutine 'REPL' moves the stack pointer and loses (on purpose) the return address.

The assembly-language subroutine 'LOAD' and the string 'STR' are the same as in Table 3 and therefore not shown, but the subroutines 'SAVE' and 'REPL' have been added, and the subroutine 'INIT' has been extended. The address of the jump command at %0008 has been changed so that interrupt service will start with the SAVE routine, which pushes the register contents, program variables and part of the existing command onto the stack. It then uses a memory pointer, initialized by 'INIT', to determine where to store the stack-pointer address. The memory pointer allows the program to keep track of more than one stack pointer address in case the interrupt service is interrupted before it is finished. It always points to the location in memory where the next stack-pointer address is going to be stored.

The 'REPL' routine performs the reverse of the 'SAVE' routine. It recovers the last stack-pointer address stored and moves the CB stack pointer to begin retrieving the necessary information. When the RET is executed, the program that was executing at the time of interrupt is reentered.

The location of the assembly-language interrupt service is entirely arbitrary with the exception that the JMP SAVE command must be located at the point to which control is transferred when an interrupt is received (in our case, location %0008). The interrupt service can be stored in PROM, provided that the memory pointer, which is changed during each service, is stored in RAM.

Give It a Try

All of the methods of handling interrupts outlined in this article have been tested and proved satisfactory. Any of the three can provide a new dimension to your real-time programming if you are willing to take the time to understand your interpreter. So if you think your application requires it, give it a try. All you need is a source listing for your interpreter and the information in this article. It is well worth the effort.■

✓ Reader Service—see page 227

NEW SOFTWARE

Edited by Dennis Brisson

TRS-80 Utility Package

MLUP-1 (Machine-Language Utility Package No. 1) is a single cassette containing six new machine-language routines for TRS-80s that use TRSDOS 2.1 or 2.2, Apparat's NEWDOS or a cassette recorder. Three identical versions of the package—16K, 32K and 48K—are contained on one cassette. It is programmed for both TRS-80 Level II and Disk BASIC. Hardware requirements include at least 16K of RAM.

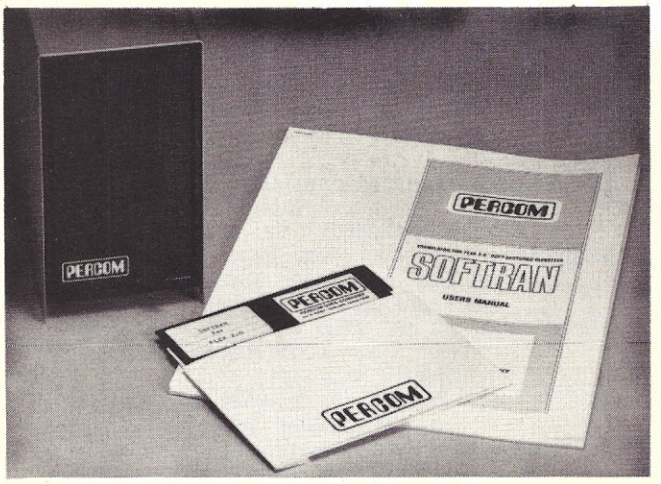
MLUP-1 eliminates keybounce, performs a formatted input routine, permits upward and downward scrolling and provides convenient insert and delete options. The keyboard debounce/repeat gives the user an auto-repeat option and lets him ignore the BREAK key, if he wants to. The input routine establishes a protected input field on the video screen and lets the user specify field length and location, numeric or string input mode and reduces GIGO because the numeric mode ignores everything except valid numeric characters. Price is $25.

Disco-Tech, PO Box 11129, Santa Rosa CA 95406. Reader Service number D69.

Translator Program

SOFTRAN, a translator program from Percom Data Company, 211 N. Kirby, Garland TX 75042, converts files on soft-sectored minidiskettes for use with Percom LFD-400 hard-sectored minidisk drive systems. The program is available for mini FLEX, FLEX 2.0 and SSB DOS.

SOFTRAN makes the LFD-400 a universal minidisk storage system; minidiskette programs from all of the principal 6800 software suppliers may be used with the LFD-400. It copies soft-sectored minidiskettes track for track onto hard-sectored minidiskettes. If the minidiskette includes a FLEX or SSB DOS, the DOS is modified to function with the LFD-400. Translation of mini FLEX and SSB DOS minidiskettes results in more than 10 percent additional storage space becoming available than required for the soft-sectored version. Price is $24.95. Reader Service number P83.



The SOFTRAN translator program.

CHECKBOOK II
Personal Checking Account Manager

From
The Bottom Shelf
Atlanta GA

This program provides the TRS-80 user with the necessary functions to interact with today's sometimes frustrating banking system. CHECKBOOK II loads using the SYSTEM command into a 16K or 32K tape-based system or 32K or greater disk-based system. The 16K tape system allows up to 75 transactions in memory at once; the 32K allows 350; while the 32K disk allows 150 with DOS. The user is initially prompted with the program's ten-option main menu:

1. Keyboard Input
2. List and Edit
3. Print with Balance
4. Search and Total
5. Reconcile
6. Sort
7. Input from Tape (or Disk)
8. Output to Tape (or Disk)
9. Check File Length
10. Clear (and Kill on Disk)

The first option is used for entry of check data. Each entry has five fields: five digits for check numbers, six digits for the date, sixteen characters for a description, seven digits for amount and four additional characters to code each transaction by type. Input of checks does not have to be in order by check number; checks are automatically sorted by check number upon completion of keyboard input.

Listing the data gives the user a chance to review the figures from any point in the file as well as edit out any mistakes. Edit mode allows modification of individual fields or deletion of entire records.

Once the user is satisfied that the information is correct, he may select the Print with Balance option. The user is prompted for the number of the first check to be displayed and the balance of the account. This balance need only be entered the first time the program is used; the balance is automatically updated and recalled during subsequent sessions. The screen listing given by this module provides the balance as a result of each withdrawal and deposit beginning with the check number specified. Thus, the user can clearly see just where the account went into the negatives.

Option 4 gives the user the ability to locate all checks with common fields, for example, to total all the checks made out to the same person or recall all checks for the same commodity (indicated by the four character type code). My only complaint is the inability to search by a given amount. For instance, to recall the purpose of that $48 check you wrote last July, you would have to scan the records manually for checks written in that time period and for that amount.

Options 7, 8 and 9 are the file-manipulation options for either disk- or cassette-based systems. Files are stored with titles indicating the check numbers contained in that particular file. CHECK FILE LENGTH tells the user how many more transactions can be added to the current file.

RECONCILE is the final operation during a session with the CHECKBOOK. In this module the user is prompted to indicate cleared checks; the program then checks the balance against the bank's monthly statement, lists outstanding checks and permanently removes cleared checks from the active file. SORT will be used if the entries are out of order.

Finally, at any point in the program that the user is being prompted for an alphanumeric input, pressing P will send whatever is on the screen to the user's printer. Make sure that the printer is connected before you try this, as all will be lost if nothing is on the printer port.

CHECKBOOK II has more than its versatile features going for it; the program flow during an operating session is logically structured, and errors are correctable before the user gets too deeply in trouble. The graphics listings are very readable, using a column format perfect for permanent records. Instead of restricting the user to one particular sequence, this program allows the user to act freely, making CHECKBOOK II the best of its kind so far and a valuable tool for use in personal banking.

Kevin Cohan
Micro Lab, ISI

Heath CP/M

The basic CP/M package for the Heathkit H17 and H89 disk system includes text editor, assembler, debugger and other system utilities plus six users' manuals. It operates directly with systems configured for HDOS. Most programs designed to run under CP/M will be available to operate with this system, including Microsoft BASIC, FORTRAN and COBOL. Price is $145.

Lifeboat Associates, 2248 Broadway, New York NY 10024.

Software

Math Library I: This 22-program package, written in Level II BASIC (TRS-80) and Release 4 BASIC (North Star), contains elementary methods for solving scientific problems. Suitable for educators, engineers, consultants and other professionals who want to apply microcomputers in solving real-world problems. TRS-80 disk (DOS 2.1) is $35; North Star disk (single density) is $45. Dr. Lee, 5819 Thomas Ave., Philadelphia PA 19143. Reader Service number L3.

Textwriter: Text-formatting program to print personalized form letters, reports and manuals, contracts and specifications or books and articles. Available for $125 on all commonly used floppy disk media in versions for use with CP/M and other similar systems. Organic Software, 1492 Windsor Way, Livermore CA 94550. Reader Service number O14.

Individual Study Center: Self-teaching educational course with subject matter for grade-school or high-school students (Puzzler, House on Fire, Around the Ball Park), as well as for adults who want to review history, French, spelling or novice ham license, etc. The four-cassette packette for the TRS-80 Level II or Apple II costs $39.94, plus $1.50 postage and handling. TYC Software, 40 Stuyvesant Manor, Geneseo NY 14454. Reader Service number T69.

Tax-Deferred Exchange Model: Shows the total financial impact—considering appreciation, depreciation, legal fees, improvements, mortgages, etc.—of a tax-deferred or partially tax-deferred property exchange. Cassette is $20 and diskette is $25 for the Apple II and TRS-80 Level II. Realty Software Company, 2045 Manhattan Ave., Hermosa Beach CA 90254. Reader Service number R33.

TIS Software: Three new software packages for the Commodore PET/CBM:

Checkbook program—assists in balancing a checkbook, selects and displays checks by person, purpose or date and sums checks by category or person.

Accounts program—creates a data base for company names, addresses, invoice and purchase order numbers and amounts of purchase.

Calendar program—enables you to keep track of appointments in the office, schedule social engagements, etc.

Each cassette costs $9.90; floppy disk is $12.95. Total Information Services, PO Box 921, Los Alamos NM 87544. Reader Service number T75.

Some Dos and Don'ts for writers and wirers.

Do write about business and educational applications.

We'd like to see more articles on the use of microcomputers in business applications. If you have a useful piece of business software, by all means write it up for *Kilobaud Microcomputing*. There's also a need for reviews of business systems. Businessmen want to know which hardware items work well together—with a minimum of hassle—and what a computer can do for them.

Educational programs are going to be BIG. If your kids are happily learning math, spelling or any other subject with the aid of your micro, please share your programs with the rest of us.

Do write in English—not computerese.

One thing: Please try hard to use as few buzzwords as possible. Remember that *Kilobaud Microcomputing* is trying to bootstrap newcomers into this field, not scare them away. If you understand your subject, you shouldn't have to be obscure.

Do send a manuscript—not an illegible printout.

Use regular typing paper (*not* the erasable type) and double-space your manuscript, leaving wide margins. Number the pages when you put your name on each page. Do not type titles, subtitles or text in all capitals. Manuscripts that are single-spaced and/or typed in all caps will automatically be returned for revision. Underlining a word indicates that it is to be in italics. Keep a carbon copy . . . just in case. Send us the original. Each page of typed copy will be equal to about one-sixth of a page in *Kilobaud Microcomputing*.

Do stick to the point; don't throw in extraneous, irrelevant material.

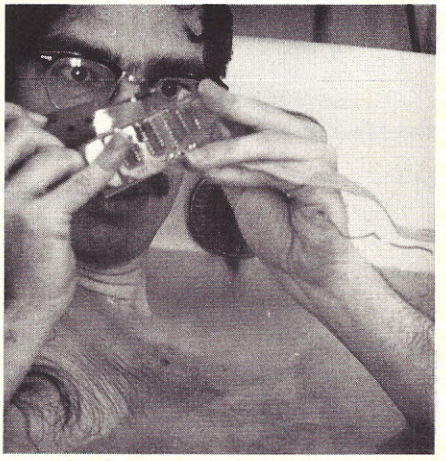
Generating an outline of your proposed article is perhaps one of the most important steps you can take (as well as, of course, sticking to it and not getting sidetracked).

Use active rather than passive voice. "I fastened the nut" is better than "the nut was fastened." Write in short, concise sentences, starting a new paragraph with each new thought.

Avoid unneccesary abbreviations and capitalizations. Use subheadings for each new section to provide signposts for the readers.

Don't make it look like a PhD thesis.

Avoid footnotes, if possible, and just put your references in the text (it's easier to read that way). And don't forget to give credit when you borrow an idea from someone else. This is important both ethically and legally.



Don't solder in the bathtub.

Do keep figures and text separate.

Put all drawings on separate sheets of paper—never in the text. We have excellent draftsmen who redraw all diagrams and schematics, so be sure that your sketches are complete, neat and readable. Put parts values on the schematic rather than in a separate parts list. Use terms "IC1,""R1" and "C2," etc., only if you are referring to them in the text. If a block diagram will be helpful in getting the "big picture," then by all means include one. Label all drawings as Fig. 1, Fig. 2 and so on. Be sure to sequentially reference figures in the text. Write a caption for each and include this with the article text so our typesetters will be able to set the type. *Put your name and page number on every sheet of paper you submit.*

Don't submit programs scrawled in crayon on grocery bags.

Important: All programs submitted to *Kilobaud Microcomputing* must be in a camera-ready condition. This means that programs should be a printout (single-spaced) and not typed. If you don't have a printer, borrow one. Programs may be typed as a last resort, but they must be single-spaced and legible. (Type carefully to avoid having to make corrections; use a carbon, rather than a fabric, ribbon.) Don't print programs on newsprint, colored paper or lined paper. Use white paper only.

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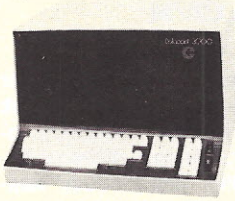

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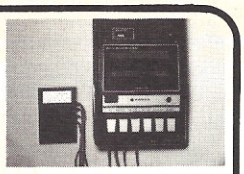

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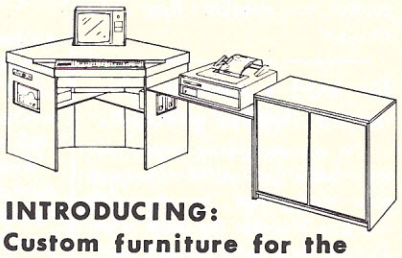

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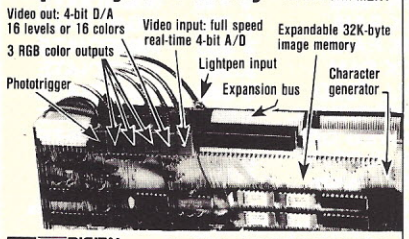

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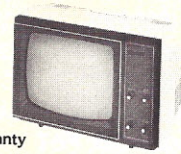

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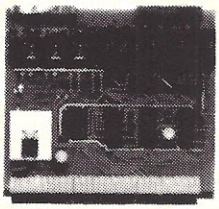

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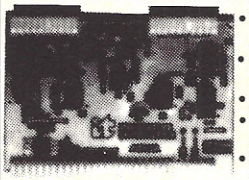

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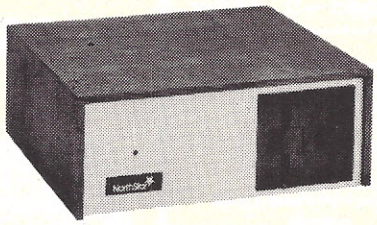

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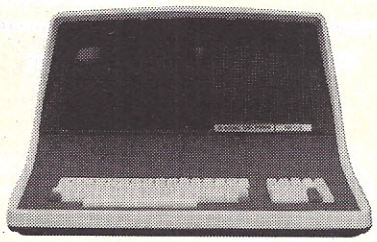

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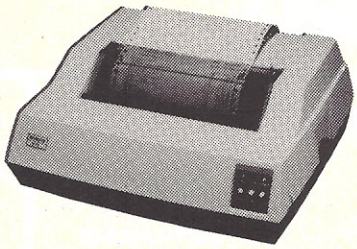

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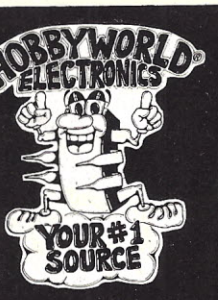

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Installs in minutes, no special tools required. Complete with detailed instructions. Wt 4 oz.

Cat No.	Description
1156	For TRS-80 keyboard unit
1156A	TRS-80 without buffered cable
1156B	TRS-80 with buffered cable
1156C	For Apple
1156D	For Exidy Sorcerer

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Cat No.	Description	Price
2172	Atari 400 Personal Computer	$550.00
2176	Digital Recorder for 400	90.00
2173	Atari 800 Personal Computer	995.00
2174	Minidisk Drive for 800	750.00
2175	Line Printer for 800	600.00

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TYPE NO.	PRICE	TYPE NO.	PRICE
1101	.79	TMS 4045-300	7.25
2101-250	1.95	4116-300	11.65
2101-450	1.25	4116-250	12.75
21L02-650	.79	4116-200	13.75
21L02-450	1.10	4116-150	14.90
21L02-250	1.25	9050 CDC	4.50
2111-400	2.95	91L02-450	.79
2114-300	7.25	1702 A	4.25
2114-200	9.75	TMS 2532	86.00
4027P-2	3.90	2708	9.15
TMS 4045-450	6.50	2716	36.75

CMOS

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TYPE NO.	PRICE	TYPE NO.	PRICE
CD 4000	.19	CD 4028	.85
CD 4001	.23	CD 4030	.45
CD 4002	.23	CD 4035	.99
CD 4006	1.09	CD 4040	1.10
CD 4007	.25	CD 4044	.79
CD 4008	.28	CD 4045	.89
CD 4009	.45	CD 4046	1.19
CD 4010	.39	CD 4049	.45
CD 4011	.28	CD 4050	.45
CD 4012	.25	CD 4051	1.15
CD 4013	.36	CD 4052	.69
CD 4014	.99	CD 4053	1.19
CD 4015	.99	CD 4066	.85
CD 4016	.45	CD 4069	.49
CD 4017	1.10	CD 4071	.26
CD 4018	.99	CD 4081	.29
CD 4019	.42	CD 4082	.29
CD 4020	1.10	CD 4510	.99
CD 4021	1.25	CD 4516	.79
CD 4022	1.10	CD 4519	.59
CD 4023	.29	CD 4522	1.25
CD 4024	.75	CD 4526	1.25
CD 4025	.26	CD 4528	.99
CD 4026	1.45	CD 4529	.49
CD 4027	.49		

74C

TYPE NO.	PRICE
74C 08	.25
74C 10	.49
74C 74	.79
74C 76	.99
74C174	1.10
74C192	1.49

74H

TYPE NO.	PRICE
74H 04	.19
74H 10	.19
74H 20	.29
74H 30	.29
74H 53	.29
74H 54	.29
74H103	1.25

74L

TYPE NO.	PRICE
74L 30	.99
74L 42	.99
74L 73	.99
74L 74	.79
74L 75	.89
74L192	1.95

74$

TYPE NO.	PRICE
74$ 00	.29
74$ 04	.99
74$ 10	.29
74$ 20	.60
74$ 30	.95
74$ 38	.79
74$ 40	.60
74$ 64	.90
74$ 86	.99
74$157	3.50
74$158	.99
74$187	2.75
74$188	7.95
74$196	3.75
74$197	3.50
74$240	9.75
74$241	4.50
74$251	4.50
74$260	.99
74$274	19.25
74$373	4.95
74$387	4.75
74$412	4.75
74$470	8.00

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74L$

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TYPE NO.	PRICE	TYPE NO.	PRICE
74L$ 00	.28	74L$157	1.45
74L$ 01	.19	74L$158	.69
74L$ 02	.29	74L$160	.99
74L$ 03	.19	74L$161	1.10
74L$ 04	.89	74L$162	.99
74L$ 05	.35	74L$163	.99
74L$ 08	.29	74L$164	1.25
74L$ 09	.25	74L$165	.89
74L$ 10	.29	74L$168	.99
74L$ 11	.59	74L$169	.99
74L$ 12	.29	74L$170	1.69
74L$ 13	.59	74L$173	1.29
74L$ 14	1.25	74L$174	.99
74L$ 15	.39	74L$175	.99
74L$ 20	.29	74L$181	2.25
74L$ 21	.29	74L$190	1.10
74L$ 22	.29	74L$191	1.10
74L$ 26	.25	74L$192	1.10
74L$ 27	.35	74L$193	1.10
74L$ 28	.39	74L$194	1.10
74L$ 30	.29	74L$195	1.10
74L$ 32	.39	74L$196	.89
74L$ 33	.39	74L$197	1.65
74L$ 37	.39	74L$221	1.25
74L$ 38	.32	74L$240	4.50
74L$ 40	.33	74L$241	2.40
74L$ 42	.89	74L$242	1.50
74L$ 47	.89	74L$243	2.50
74L$ 48	.79	74L$244	2.60
74L$ 51	.29	74L$247	1.10
74L$ 54	.29	74L$248	1.10
74L$ 55	.29	74L$251	1.99
74L$ 73	.44	74L$253	.99
74L$ 74	.59	74L$257	.99
74L$ 75	.49	74L$258	.99
74L$ 76	.45	74L$259	1.99
74L$ 83	.89	74L$260	.69
74L$ 85	1.25	74L$261	1.75
74L$ 86	.45	74L$266	.49
74L$ 90	.49	74L$273	1.50
74L$ 92	.75	74L$275	4.50
74L$ 93	.59	74L$279	.75
74L$ 95	.99	74L$283	.79
74L$ 96	1.15	74L$293	1.95
74L$107	.39	74L$295	.99
74L$109	.45	74L$298	.79
74L$112	.29	74L$365	.85
74L$113	.29	74L$366	.79
74L$114	.29	74L$367	.85
74L$122	.49	74L$368	.85
74L$123	.99	74L$373	3.05
74L$124	1.35	74L$374	1.95
74L$125	.89	74L$377	3.90
74L$126	.39	74L$378	1.25
74L$132	.79	74L$386	.65
74L$138	.88	74L$393	1.95
74L$139	.88	74L$395	1.45
74L$145	1.25	74L$399	2.95
74L$151	.67	74L$424	1.95
74L$153	.79	74L$668	1.25
74L$154	1.79	74L$670	2.49
74L$155	.89	81L$ 96	1.45
74L$156	.69	81L$ 97	1.55

Special Purpose IC's

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Type	Description	PRICE
11C90	650 MHz prescaler	16.50
AY5-1013A	UART, 30K baud	4.50
AY5-1014A	UART, 40K baud	7.75
FD1771B01	Floppy disk controller	39.00
BR1941L	Dual baud rate gen	9.50
KR2376-ST	ASCII keyboard encoder	9.50
2513	Character gen, upper case	9.50
7107	DPM, led	10.75
ICM7207A/7208	Frequency counter	24.00
8038	Voltage controlled oscillator	3.95
DM8131	6-bit bus comparator	2.40
DM8833	single ended line trans	.90
DM8836	line receiver, single ended	.80
TA7205P	4.8 watt audio amp	2.75
SN76477	Sound generator	3.50
MM5375AC	6 digit clock, com anode	1.75
IH5004	2xSPST jfet switch w/driver	.90
MC14410	Touch tone encoder	8.50
MC14411	Baud rate generator, 1MHz	15.00
8271	Floppy disk controller	17.50

TTL

Order by Cat No. 999 and type

TYPE NO.	PRICE	TYPE NO.	PRICE
7400	.16	74109	.55
7401	.18	74116	1.95
7402	.18	74120	1.25
7403	.18	74121	.35
7404	.19	74122	.39
7405	.19	74123	.49
7406	.19	74125	.39
7407	.19	74126	.44
7408	.19	74128	.49
7409	.19	74132	.69
7410	.19	74136	.75
7411	.25	74139	.69
7412	.25	74141	.79
7413	.35	74143	2.75
7414	.60	74145	.65
7416	.19	74148	1.25
7417	.25	74150	.89
7420	.19	74151	.59
7422	.79	74153	.59
7423	.22	74154	.99
7425	.25	74155	.75
7426	.35	74156	1.12
7430	.19	74157	.65
7432	.25	74160	.85
7437	.25	74161	.79
7438	.25	74162	.89
7439	.27	74163	.79
7440	.45	74164	.89
7441	.70	74165	.89
7442	.49	74166	1.29
7443	.59	74170	1.59
7444	.59	74173	.99
7445	.69	74174	.85
7446	.69	74175	.79
7447	.59	74176	.79
7448	.69	74177	.75
7450	.19	74179	1.89
7451	.19	74780	.79
7453	.19	74181	1.89
7454	.19	74182	1.25
7460	.19	74184	1.95
7470	.33	74185	1.95
7472	.28	74190	1.25
7473	.35	74191	1.25
7474	.29	74192	.75
7475	.39	74193	.75
7476	.35	74194	.89
7479	4.75	74195	.69
7480	.49	74196	.89
7481	.99	74197	.89
7482	.99	74198	1.49
7483	.59	74199	1.49
7485	.69	74221	1.45
7486	.35	74251	1.09
7489	1.75	74273	1.10
7490	.39	74278	3.00
7491	.55	74279	.85
7492	.43	74298	.95
7493	.43	74365	.68
7494	.79	74366	.68
7495	.65	74376	.68
7496	.65	74368	.68
7497	2.90	74393	3.25
74100	1.42	8T97	1.65
74107	.29		

LINEARS

Order by Cat No. 999 and type

TYPE NO.	PRICE	TYPE NO.	PRICE
101 H	1.79	340 K-24	1.75
103 H-3.9	1.39	340 T-5	.99
103 H-5.1	1.39	340 T-6	.99
103 H-5.6	1.39	340 T-8	.99
301 AH	.39	340 T-12	.99
301 AN-8	.32	340 T-15	.99
304 H	2.25	340 T-18	.99
305 H	1.30	340 T-24	.99
307 N	.49	358 N-8	.59
308 H	.79	379 M	5.75
308 N-8	.59	381 N	2.75
308 AH	.99	386 N	.79
309 H	1.10	387 AN	1.25
309 K	1.50	389 N	1.85
311 H	.88	394 H	3.50
311 N	.88	555 N-8	.35
311 N-8	.49	556 N	.79
312 H	1.95	565 N	.99
317 T	2.75	567 N	.99
317 H	2.75	703 N-8	.49
318 N-8	.79	709 N-8	.25
319 H	1.30	723 N	.49
320 H-5	.95	741 N	.39
320 H-6	.95	741 N-8	.39
320 H-12	.95	741 H	.79
320 H-15	.95	747 H	1.25
320 H-24	.95	747 N	1.25
320 K-5	1.90	1455	1.25
320 K-12	1.90	1458 N-8	.49
320 K-15	1.85	1488 N	1.49
320 K-24	1.85	1489 N	1.39
320 T-5	1.10	1889 N	2.95
320 T-12	1.10	2900 N	.99
320 T-15	1.10	3302	.39
320 T-24	1.10	3401	.55
321 H	6.50	3900	.55
322 H	1.75	3911	.99
323 K	5.95	4194	5.95
324 N	.89	4250	1.25
339 N	.99	5369 N-8	1.95
340 K-5	1.75	75451	.39
340 K-8	1.75	75452	.79
340 K-12	1.75	75453	.49
340 K-15	1.75	75491	.99
340 K-18	1.75		

VOLTAGE REGULATORS

Order by Cat No. 999 and type

Type	Price
LM320K5	$1.90
LM320K12	1.90
LM320K15	1.90
LM340K5	1.75
LM340K12	1.75
LM340K15	1.75
LM340K18	1.75
7805T	.99
7806T	.99
7812T	.99
7815T	.99
7818T	.99
7824T	.99
7905T	1.10
7912T	1.10
7915T	1.10

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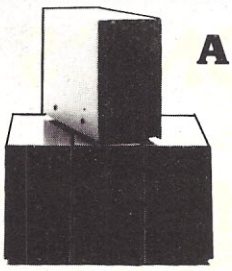

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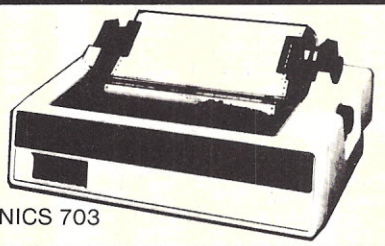

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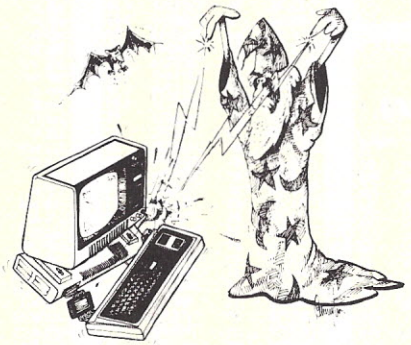

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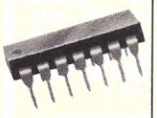

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74LS00	276-1900	.49
74LS02	276-1902	.59
74LS04	276-1904	.59
74LS08	276-1908	.49
74LS10	276-1910	.59
74LS13	276-1911	.99
74LS20	276-1912	.59
74LS27	276-1913	.69
74LS30	276-1914	.59
74LS32	276-1915	.69
74LS47	276-1916	1.29
74LS51	276-1917	.59
74LS73	276-1918	.69
74LS74	276-1919	.69
74LS75	276-1920	.99
74LS76	276-1921	.79
74LS85	276-1922	1.29
74LS90	276-1923	.99
74LS92	276-1924	.99
74LS93	276-1925	.99
74LS123	276-1926	1.19
74LS132	276-1927	.99
74LS151	276-1929	.99
74LS157	276-1930	1.19
74LS161	276-1931	1.49
74LS164	276-1932	1.49
74LS175	276-1934	1.19
74LS192	276-1935	1.49
74LS193	276-1936	1.49
74LS194	276-1937	1.49
74LS196	276-1938	1.59
74LS367	276-1835	1.19
74LS368	276-1836	1.19
74LS373	276-1943	2.39
74LS374	276-1944	2.39

4000-Series CMOS ICs

Type	Cat. No.	EACH
4001	276-2401	.69
4011	276-2411	.69
4012	276-2412	.79
4013	276-2413	.99
4017	276-2417	1.69
4020	276-2420	1.69
4021	276-2421	1.69
4023	276-2423	.69
4027	276-2427	.99
4028	276-2428	1.29
4046	276-2446	1.89
4511	276-2447	1.69
4049	276-2449	.79
4050	276-2450	.79
4051	276-2451	1.49
4066	276-2466	1.39
4070	276-2470	.79
4518	276-2490	1.49
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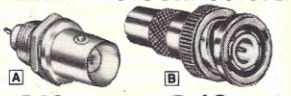

A 1.49 **B 2.19**

A Type 1094 Female BNC. Mounts in single 5/16" hole. **278-105** **1.49**

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For RG-58/U Cable. 278-103..... **2.19**
For RG-59/U Cable. 278-104..... **2.19**

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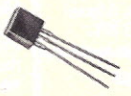

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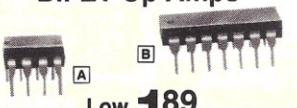
276-1646 ..... **Pkg. of 3/1.98**

BIFET Op Amps



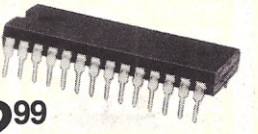
Low As **1.89**

Feature very high input impedance, low noise. Fast 13V/μS slew rate is ideal for low TIM distortion audio amplifiers. Internally compensated. Up to ±18V supply.

A LF 353N. Dual BIFET Op amp. 8-pin DIP. **276-1715** **1.89**

B TL 084C. Quad BIFET Op amp. 14-pin DIP. **276-1714**..... **2.99**

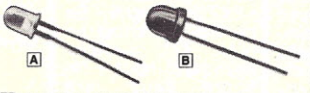
SN-76477 "Music Synthesizer" IC



2.99

Creates almost any type of sound! High level op amp output. Includes 2 VCOs, low frequency osc., noise generator, filter, 2 mixers, timing logic. 28-pin DIP. With data. **276-1765**..... **2.99**

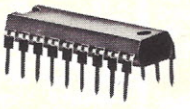
Unique LEDs



A Tri-Color. Displays red, green, yellow. Uniform light output of 0.6 mcd. Forward voltage: 2.2VDC. Max. current: 25mA. T1-¾ case style.
276-035 ..... **1.39**

B Red Flasher. Operates directly from 5VDC power source. Pulse rate: 3 Hz. Max. current: 20 mA at 5VDC.
276-036 ..... **1.29**

LED Bar/Dot Display Driver

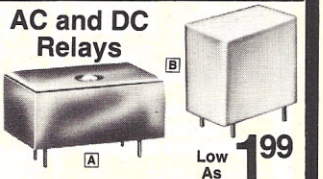


3.49

LM3914N. Features 10 adjustable analog steps, bar or dot display mode. Current-regulated LED ouputs. 8 to 25VDC supply. 18-pin DIP. **276-1707** **3.49**

LM3915N. As above but with 3 dB log steps. **276-1708** **3.49**

AC and DC Relays



Low As **1.99**

A SPST Solid State AC Relay. Handles 24 to 280VAC at up to 1.5A. TTL compatible 5VDC control input. 1500VRMS isolation.
275-236 ..... **1.99**

B 12VDC SPDT. Silver-plated contacts: 1A at 125VAC. **275-231** **2.49**

Manufacturer's Data Books

Low As **2.95**

Need Info?—Find it at Radio Shack!

A Motorola RF Data Manual. Power and small-signal RF transistors, hybrid amplifier modules, more. **62-1380** **4.95**

B Motorola Low-Power Schottky TTL. Data and diagrams plus selection guide for choosing best device. **62-1381** **3.95**

C Linear Applications, Vol. 2. Latest data, diagrams, applications briefs and articles. Indexed. **62-1374** **2.95**

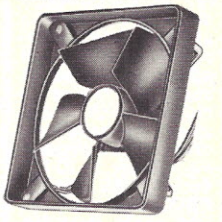
D CMOS Integrated Circuits. Covers 74C, CD4000-series with complete data, diagrams. Cross referenced. **62-1375** **3.95**

E Memory Data Book. Complete info on MOS and bipolar memory components, support circuits. **62-1376** **3.95**

4" Cooling Fan

12.95

Super Quiet Operation



Ideal for cooling power supplies, microcomputers, hi-fi and Ham gear. Delivers up to 70 CFM. Diecast venturi. U.L. recognized motor. For 120VAC, 60 Hz.
273-241 ..... **12.95**

12/24-Hr. LCD Clock Module

19.95

24-Hour Alarm Shows Time/Day/Date

Actual Size

Complete clock module — just add switches and battery! 0.25" LCD display has built-in backlight, alarm set, PM and snooze indicators. Operates up to a year on single 1.5V battery. Accuracy: ±13 seconds per month. **277-1005**..... **19.95**

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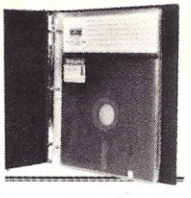
COMPUCRUISE

Put a computer in your car, which gives you the most effective and functional cruise control ever designed, plus complete trip computing, fuel management systems, and a remarkable accurate quartz crystal time system.

So simple a child can operate, the new CompuCruise combines latest computer technology with state-of-the-art reliability in a package which will not likely be available on new cars for years to come • Cruise Control • Time, E.T., Lap Timer, Alarm • Time, Distance, Fuel to Arrival • Time, Distance, Fuel to Empty • Time, Distance and Fuel on Trip • Current or Average MPG, GPH • Fuel Used, Distance since Fillup • Current and Average-Vehicle Speed • Inside, Outside or Coolant Temperature • Battery Voltage • English or Metric Display. $199.95 , without cruise control $159.95.

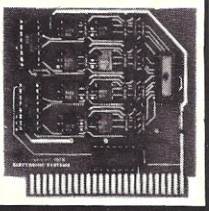
FLOPPY DISK STORAGE BINDER

This black vinyl three-ring binder comes with ten transparent plastic sleeves which accommodate either twenty, five-inch or ten, eight-inch floppy disks. The plastic sleeves may be ordered separately and added as needed. A contents file is included with each sleeve for easy identification and organizing. Binder & 10 holders $14.95 Part No. B800; Extra holders 95¢ each. Part No. 800



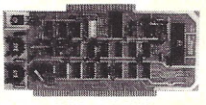
OPTO-ISOLATED PARALLEL INPUT BOARD FOR APPLE II

There are 8 inputs that can be driven from TTL logic or any 5 volt source. The circuit board can be plugged into any of the 8 sockets of your Apple II. It has a 16 pin socket for standard dip ribbon cable connection.
Board only $15.00. Part No. 120, with parts $69.95. Part No. 120A.



TIDMA

● Tape Interface Direct Memory Access ● Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate ● S-100 bus compatible ● Board only $35.00 Part No. 112, with parts $110 Part No. 112A



SYSTEM MONITOR

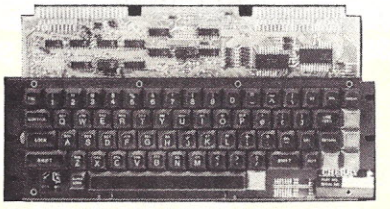
8080, 8085, or Z-80 System monitor for use with the TIDMA board. There is no need for the front panel. Complete with documentation $12.95.

16K EPROM

Uses 2708 EPROMS, memory speed selection provided, addressable anywhere in 65K of memory, can be shadowed in 4K increments. Board only $24.95 part no. 7902, with parts less EPROMs $49.95 part no. 7902A.

ASCII KEYBOARD

TTL & DTL compatible • Full 67 key array • Full 128 character ASCII output • Positive logic with outputs resting low • Data Strobe • Five user-definable spare keys • Standard 22 pin dual card edge connector • Requires +5VDC, 325 mA. Assembled & Tested. Cherry Pro Part No. P70-05AB. $119.95.



ASCII KEYBOARD

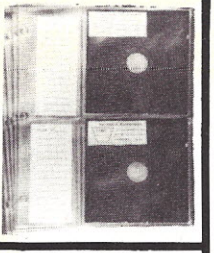
53 Keys popular ASR-33 format • Rugged G-10 P.C. Board • Tri-mode MOS encoding • Two-Key Rollover • MOS/DTL/TTL Compatible • Upper Case lockout • Data and Strobe inversion option • Three User Definable Keys • Low contact bounce • Selectable Parity • Custom Keycaps • George Risk Model 753. Requires +5, -12 volts. $59.95 Kit.

ASCII TO CORRESPONDENCE CODE CONVERTER

This bidirectional board is a direct replacement for the board inside the Trendata 1000 terminal. The on board connector provides RS-232 serial in and out. Sold only as an assembled and tested unit for $229.95. Part No. TA 1000C

DISK JACKET™

Made from heavy duty .0095 matte plastic with reinforced grommets. The mini-diskette version holds two 5-1/4 inch diskettes and will fit any standard three ring binder. The pockets to the left of the diskette can be used for listing the contents of the disk. Please order only in multitudes of ten. $9.95/10 Pack.



ATARI 800

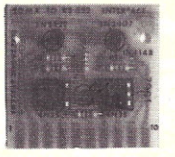
Computer with 8K $995.00, disk drive $549.00, printer $599.99

VIDEO TERMINAL

16 lines, 64 columns • Upper and lower case • 5x7 dot matrix • Serial RS-232 in and out with TTL parallel keyboard input • On board baud rate generator 75, 110, 150, 300, 600, & 1200 jumper selectable • Memory 1024 characters (7-21L02) • Video processor chip SFF96364 by Neculonic • Control characters (CR, LF, →, ←, ↑, ↓, non destructive cursor, CS, home, CL • White characters on black background or vice-versa • With the addition of a keyboard, video monitor or TV set with TV interface (part no. 107A) and power supply this is a complete stand alone terminal • also S-100 compatible • requires +16, & −16 VDC at 100mA, and 8VDC at 1A. Part No. 1000A $199.95 kit.

RS-232/20mA INTERFACE

This board has two passive, opto-isolated circuits. One converts RS-232 to 20mA, the other converts 20mA to RS-232. All connections go to a 10 pin edge connector. Requires +12 and -12 volts. Board only $9.95, part no. 7901, with parts $14.95 Part No. 7901A.



COMPUCOLOR II

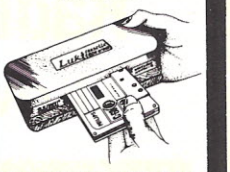
Model 3, 8K $13 95, Model 4, 16K $15 95, Model 5, 32K $18 95. Prices include color monitor, computer, and one disk drive.

PET COMPUTER

With 32K & monitor - $1195. Dual Disk Drive - $1195.

apple II or APPLE II PLUS 16K $979.00

CASSETTE TAPE ERASER



REMOVES RECORDINGS IN ONE SECOND! The process eliminates static positive / negative ions and maintains original tone quality with minimal tape hiss • To improve tone quality • To reduce hissing • For quick and easy to erase • No battery or liquid required • Powerful and effective action • Unconditional 2 year guarantee. ERASER-8 $19.95.

16K RAMS

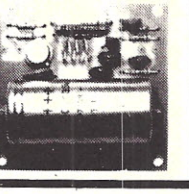
For the Apple, TRS-80 or Pet $8 each Part No. 4116/2117.

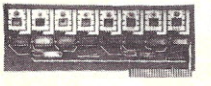
APPLE II HOBBY/PROTOTYPING CARD

$14.95 Part No. 7907

T.V. INTERFACE

● Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple ● Power required is 12 volts AC C.T., or +5 volts DC ● Board only $7.60 part No. 107, with parts $13.50 Part No. 107A





PARALLEL TRIAC OUTPUT BOARD FOR APPLE II

This board has 8 triacs capable of switching 110 volt 6 amp loads (660 watts per channel) or a total of 5280 watts. Board only $15.00 Part No. 210, with parts $119.95 Part No. 210A.

To Order: Mention part no. description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders in the U.S. only, or a VISA or Master Charge no., expiration date, signature, phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling. Payment must be in U.S. dollars. Dealer inquiries invited. 24 hour order line (408) 448-0800

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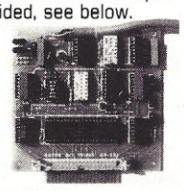
ELECTRONIC SYSTEMS Dept. KB P. O. Box 21638, San Jose, CA USA 95151

TRS-80 E.S. SERIAL I/O

• Can input into basic • Can use LLIST and LPRINT to output, or output continuously • RS-232 compatible • Can be used with or without the expansion bus • On board switch selectable baud rates of 110, 150, 300, 600, 1200, 2400, parity or no parity odd or even, 5 to 8 data bits, and 1 or 2 stop bits. D.T.R. line • Requires +5, -12 VDC • Board only $19.95 Part No. 8010, with parts $59.95 Part No. 8010A, assembled $79.95 Part No. 8010 C. No connectors provided, see below.



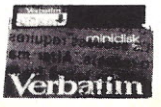
EIA/RS-232 connector Part No. DB25P $6.00, with 9', 8 conductor cable $10.95 Part No. DB25P9.

3' ribbon cable with attached connectors to fit TRS-80 and our serial board $19.95 Part No. 3CAB40.

MODEM

• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 Ω speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board only $7.60 Part No. 109, with parts $27.50 Part No. 109A

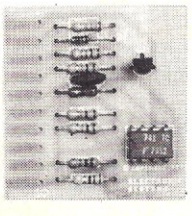
DISKETTES



Box of 10, 5" $29.95, 8" $39.95.
Plastic box, holds 10 diskettes, 5" - $4.50, 8" - $6.50.

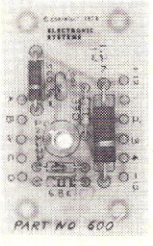
RS-232/ TTL INTERFACE

• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin gold plated edge connector, kit $ 9.95 Part No. 232A 10 Pin edge connector $3.00 Part No. 10P.

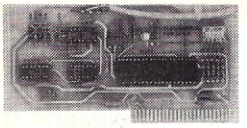


RS-232/TTY INTERFACE

This board has two active circuits, one converts RS-232 to 20mA, and the other converts 20mA to RS-232. Requires +12 and -12 volts. $9.95 Part No. 600A Kit.



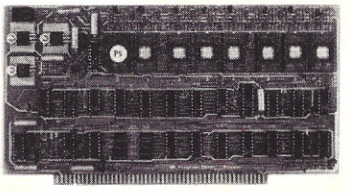
APPLE II* SERIAL I/O INTERFACE



Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. • Also watches DTR • Board only $15.00 Part No. 2, with parts $42.00 Part No. 2A, assembled $62.00 Part No. 2C

8K EPROM PIICEON

Saves programs on PROM permanently (until erased via UV light) up to 8K bytes. Programs may be directly run from the program saver such as fixed routines or assemblers. • S-100 bus compatible • Room for 8K bytes of EPROM non-volatile memory (2708's). • On-board PROM programming • Address relocation of each 4K of memory to any 4K boundary within 64K • Power on jump and reset jump option for "turnkey" systems and computers without a front panel • Program saver software available • Solder mask both sides • Full silkscreen for easy assembly. Program saver software in 1 2708 EPROM $25. Bare board $35 including custom coil, board with parts but no EPROMS $139, with 4 EPROMS $179, with 8 EPROMS $219.



WAMECO PRODUCTS WITH ELECTRONIC SYSTEMS PARTS

FDC-1 FLOPPY CONTROLLER BOARD will drive shugart, pertek, remex 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM (not included). PCBD $42.95

FPB-1 Front Panel. (Finally) IMSAI size hex displays. Byte or instruction single step. PCBD $42.95

MEM-1A 8Kx8 fully buffered, S-100, uses 2102 type RAMS. PCBD ..... $24.95, $168 Kit

QMB-12 MOTHER BOARD, 13 slot, terminated, S-100 board only ..... $34.95 $89.95 Kit

CPU-1 8080A Processor board S-100 with 8 level vector interrupt PCBD .. $25.95 $89.95 Kit

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD ..... $25.95, $60.95 Kit

EPM-1 1702A 4K EPROM card PCBD ..... $25.95 $49.95 with parts less EPROMS

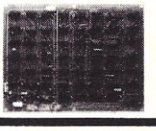
EPM-2 2708/2716 16K/32K EPROM card PCBD ..... $24.95 $49.95 with parts less EPROMS

QMB-9 MOTHER BOARD. Short Version of QMB-12. 9 Slots PCBD ..... $30.95 $67.95 Kit

MEM-2 16Kx8 Fully Buffered 2114 Board PCBD ..... $25.95, $269.95 Kit

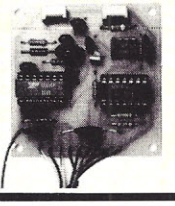
T.V. TYPEWRITER

• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled curser • Auto scroll • Non-destructive curser • Curser inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only $39.00 Part No. 106, with parts $145.00 Part No. 106A



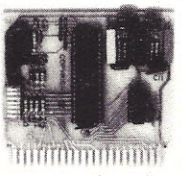
TAPE INTERFACE

• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board only $7.60 Part No. 111, with parts $27.50 Part No. 111A



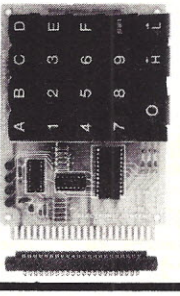
UART & BAUD RATE GENERATOR

• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only $12.00 Part No. 101, with parts $35.00 Part No. 101A, 44 pin edge connector $4.00 Part No. 44P



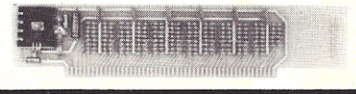
HEX ENCODED KEYBOARD E.S.

This HEX keyboard has 19 keys, 16 encoded with 3 user definable. The encoded TTL outputs, 8-4-2-1 and STROBE are debounced and available in true and complement form. Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX-3A. 44 pin edge connector $4.00 Part No. 44P.



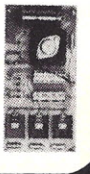
S-100 BUS ACTIVE TERMINATOR

Board only $14.95 Part No. 900, with parts $24.95 Part No. 900A



DC POWER SUPPLY

• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50 Part No. 6085, with parts excluding transformers $42.50 Part No. 6085A



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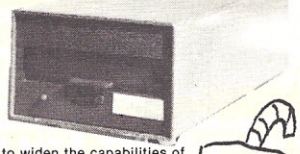
The Vista V80: widen the ability of your TRS-80 $395.00



The Vista V80 Mini Disk System is the perfect way to widen the capabilities of your TRS-80* Micro-computer. Quickly and inexpensively. Our $395 price tag is about $100 less than the Radio Shack equivalent. Our delivery time is immediate. And our system is fully interchangeable. That's just the start.

It will give you 23% more storage capacity by increasing useable storage from 55,000 to 65,000 bytes per drive with our new software patch.

It can work 8 times faster than the TRS-80 Mini-Disk system, because track-to-track access is 5ms versus 40ms for the TRS-80. You can realize this added speed once the new double disk expansion interface is available without expensive modification of the existing unit.

It has a better warranty than any comparable unit warranty available - a full 120 days on all parts and service. When you consider how much more goes into the Vista V80, that shows a lot of faith in our product.

A full 3 amp power supply means you have 2½ times the power necessary to operate the V80, and full ventilation insures that there will be no problems due to overheating.

The Vista V80 Mini Disk System requires Level II Basic with 16 K RAM Expansion interface (it operates from the Radio Shack interface system. It comes complete with a dependable MPI Minifloppy disk drive, power supply, regulator board and vented case. It's shipped to you ready to run-simply take it out of the box and plug it in. You're in business. From the company that means business - Vista Computer Company.

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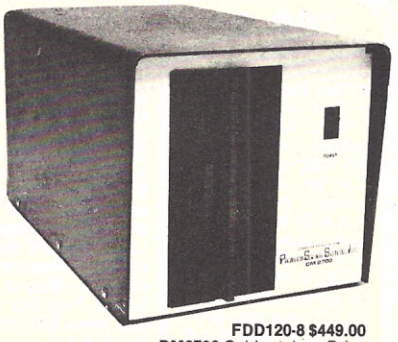

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- Write Protect
- Hard Sector Detection
- 500 KB/S Transfer
- 800 KB unformated
- Bit density 6536 BP1
- Shugart 800 Series Compatable

Cabinet includes:

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- Data Cable
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- Accepts per SCI, Shugart, Siemans 8" Drives

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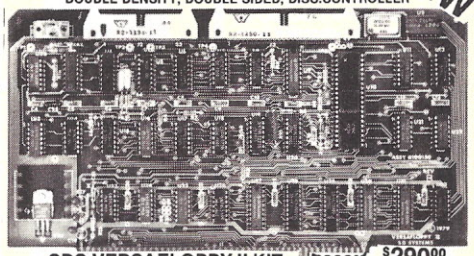
NEW VERSAFLOPPY II NEW

DOUBLE DENSITY, DOUBLE SIDED, DISC.CONTROLLER



GENERAL DESCRIPTION:
Versafloppy II is a flexible disk drive controller that incorporates a wide range of capabilities into one board. It operates with double density soft sectored format which provides 985,600 bytes of storage on a double sided 8 inch diskette and 129,920 bytes per side on a five inch mini-diskette. The Versafloppy II directly controls many popular disk drives. These include: Shugart SA400 and SA450; Shugart SA800 and SA850; Mayflower MFE500 and MFE700; Per Sci 70 and 277; and Siemans, BSI-105.

- S-100 Bus IEEE Standard Compatible
- IBM-3740 Compatible Soft Sectored Format for Single Density Drives
- Operates with both Standard (8") and Mini (5") Drives Simultaneously
- Provides Control for Double Sided Operation
- Operates with Z80, 8080, and 8085 Central Processing Unit
- Controls up to four drives
- Vectored Interrupt Operation Optional
- Control and Diagnostic Software Available in PROM
- SDOS Disk Operating System Compatible

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M-XVI

The true 16K Static Ram module for S-100 bus systems.

ASSEMBLED & TESTED -- 100% BURN IN

The M-XVI gives you unbelievable expansion capability for your S-100 bus system -even beyond 64K. Manufactured to the highest industry standards documented and designed to make assembly, use, and programming a snap. The M-XVI board is a true revelation for the serious hobbyist and use in practical business or industrial applications.

FEATURES:

- Fully static
- Uses popular 2114 static RAMS
- +5 volt operation only
- Bank Select available by bank port and bank byte
- Phantom line capability
- Addressable in 4K blocks
- 4K blocks can be addressed any where within 64K in 4k increments
- Meets IEEE proposed S-100 signal standards
- LED indicators for board selection and bank selection
- FR-4 epoxy PC boards
- Solder masked on both sides
- Silk screen of part number and part designator

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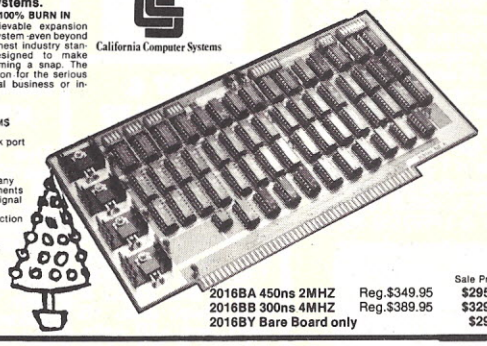

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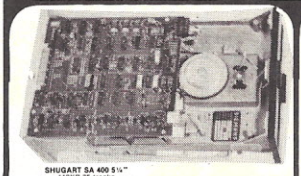

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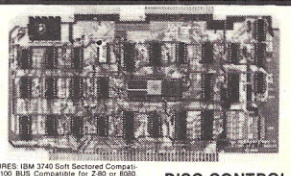

FEATURES: IBM 3740 Soft Sectored Compatible. S-100 BUS Compatible for Z-80 or 8080. Controls up to 4 Drives (single or double sided). Directly controls the following drives:

1. Shugart SA400/450 Mini Floppy
2. Shugart SA800/850 Standard Floppy.
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4. MFE 700/750
5. CDC 9404/9406
6. GSI/Siemans FDD120-8

34 Pin Connector for Mini Floppy. 50 Pin Connector for Standard Floppy. Operates with modified CP/M operating system and C-Basic Computer. The new "Versafloppy" from S.D. Computer Products provides complete control for many of the available Floppy Disk Drives. Both Mini and Full Size. FD1771B-1 Single Density Controller Chip. Listings for Control Software are included in price.
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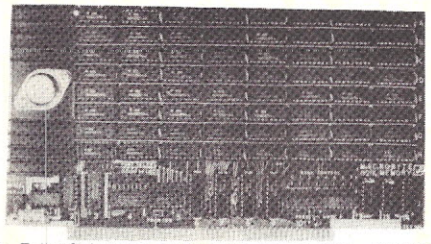

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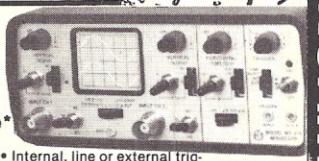

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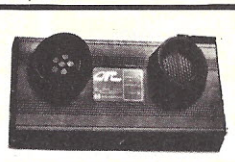

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4 MHZ EXPANDORAM II KIT
The S-100 Memory Board for the 80's

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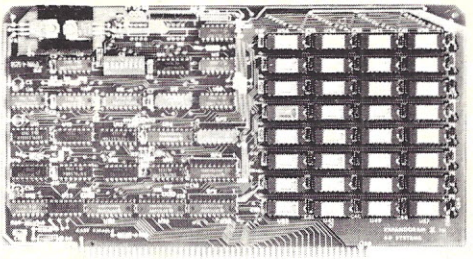


SD SYSTEMS' ExpandoRAM II is a state-of-the-art dynamic RAM board with capacities from 16K bytes (4116) to 256K bytes (4164). It operates on the industry S-100 Bus. The ExpandoRAM II's design allows eight boards to operate from the same S-100 Bus. Page mode operation provides the system with the capability of servicing multiple users without RAM interference. Invisible refresh and synchronization with wait states provide greater reliability, and processing speeds up to 4 Mhz.

The ExpandoRAM II is compatible with most S-100 CPU's based on the Z80 microprocessor. When other SD SYSTEMS 200 series boards are combined with the ExpandoRAM II, they create a microcomputer with exceptional capabilities and features.

- S-100 Bus Compatible
- Up to 4Mhz Operation
- Expandable Memory from 16K to 256K
- DIP Switch Selectable Boundaries
- Uses 16K (4115) or 64K (4164) Memory Devices
- Page Mode Operation Allows up to 8 Memory Boards on Bus
- Operates with Z80 CPU's
- Phantom Output Disable
- Invisible Refresh (Synchronized with Wait States)

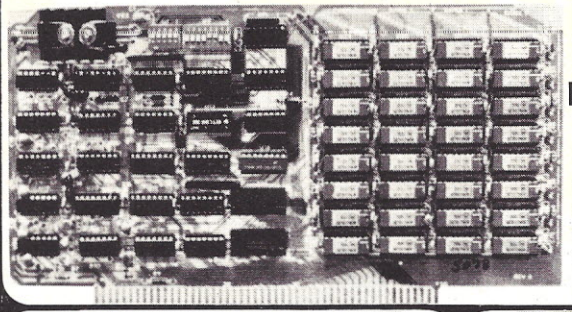
WOW

Sale Price

SDS - EXPANDORAM II KIT (4116)

16K	$280.00	48K	$450.00
32K	$365.00	64K	$535.00

SD EXPANDORAM *The Ultimate S-100 Memory*

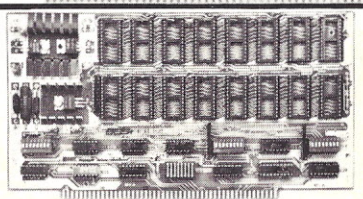


The EXPANDORAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisable on-board refresh, and IT WORKS!

- Interfaces with Altair, IMSAI, SOL-8, Cromenco, SBC-100, and others.
- Bank Selectable
- Phantom
- Power 8VDC, ± 16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Popular 4116 RAMS
- PC Board is doubled solder masked and has silk-screen parts layout.
- Extensive documentation clearly written
- Complete Kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required.
- 16K boundries and Protection via Dip Switches
- Designed to work with Z-80, 8080, 8050 CPU's

EXPANDO 64 KIT (4116)

	Reg. Price	Sale Price
16K	$249	$219
32K	$324	$285
48K	$399	$355
64K	$474	$415



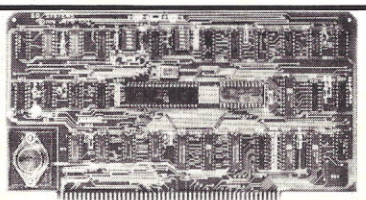
EXPANDOPROM

The ExpandoPROM can be populated with either the 2708 (1K) or the 2716 (2K) EPROMS, and may be located on either 16K or 32K boundaries.

- S-100 Bus Compatible
- Expandable Read Only Memory from 1K to 32K
- Each EPROM is Dip Switch Selectable
- Dip Switch for Addressing on 16K/32K Boundaries
- Dip Switch Selectable Wait States
- Interfaces with Imsai, Altair, Sol-20 Cromemco and SD SYSTEMS' Z80 CPU Cards

Sale Price

SDS-EXPANDOPROM KIT.....$136.00
SDS-EXPANDOPROM KIT.....$210.00



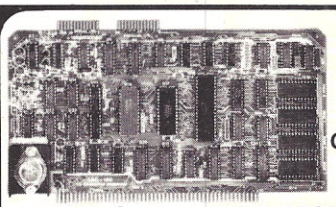
Z80 CENTRAL PROCESSING UNIT

- S-100 Bus Compatible
- Z80 Microprocessor
- 2 Mhz or 4 Mhz Operation
- Power-On Jump to any 4K Boundary
- On-Board Socket for up to 2K PROM
- Front Panel Usage Optional
- Optional Wait States

The MPB-100 can upgrade an existing S-100 8080 System with little or no necessary modifications. The MPB-100 is additionally suited for some control applications. The PROM socket will accomodate a 1K or 2K PROM plus the single voltage 4K PROM.

Sale

SDS-MPB-100 KIT.....$199.00
SDS-MPB-100 A&T.....$289.00



SINGLE BOARD COMPUTER
With On-Board RAM, PROM, CTC

- S-100 Bus Compatible
- Z80 Central Processing Unit
- 1024 Bytes of Random Access Memory
- 8K Bytes of PROM using 2716
- Parallel Input and Output Ports
- Four Channel Counter/Timer (Z80-CTC)
- Software Programmable Baud Rate Generator
- No Front Panel Required for Operation

Sale Price

SDS-SBC-100 2MHZ KIT.....$219.00
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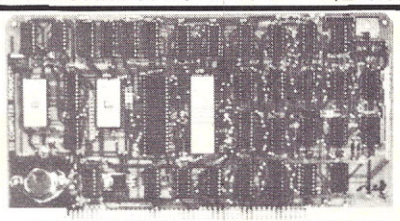
SDS-SBC-200 4MHZ KIT.....$259.00
SDS-SBC-200 4MHZ A&T.....$369.00



VDB-8024 VIDEO DISPLAY BOARD
With on-board Z80 Microprocessor

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- Blinking, Underlining, Field Reverse, Field Protect and Combinations
- Full Cursor Control
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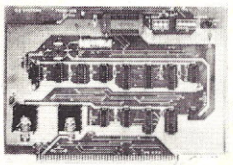
- 32 Special Character Set
- 128 Additional User Programmable Characters (Optional)
- On-Board Z80 Microprocessor
- 2K Bytes Independent On-Board RAM Memory
- Glitch-Free Display

Sale Price

SDS-VDB-8024 KIT.....$315.00
SDS-VDB-8024 A&T.....$469.00



PROM-100
Programming Board for PROM Development

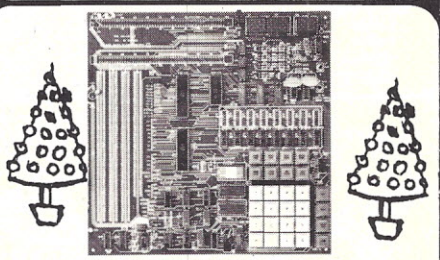
NEW

SD SYSTEMS' PROM-100 is a versatile PROM programming board offering complete EPROM programming capability. The board operates on the industry standard S-100 Bus. Support software verifies the erasure of EPROM and verifies the loaded program. SD SYSTEMS' PROM-100 offers a support-software listing with its operations manual.

- S-100 Bus Compatible
- Programs the Following EPROM s: 2708, Intel 2758, 2716, 2732 and Texas Instruments 2516
- Dip Switch Selection of EPROM type
- 25 VDC Programming Pulse Generated On Board
- Maximum Programming time: 16,384 Bits in 100 Seconds
- Power Requirement: +8VDC at 300 ma.; +16 VDC atr 100 ma.; −16 VDC at 60 ma.
- TTL compatible
- Software Provides for Reading of Object File from SDOS, CP/M or PROM and Programming into EPROM
- Program Verification • Verification of Erasure
- Zero Insertion Force Socket

Sale Price

SDS-PROM-100 KIT.....$149.00
SDS-PROM-100 A&T.....$219.00



Z80 STARTER KIT
A Complete Microcomputer On A Board

- Z80 CPU with 158 Instructions
- On-Board Keyboard and Display
- On-Board PROM Programmer for Single Voltage PROMS (2716, 2758, TI2516)
- Kansas City Standard Cassette Interface
- Simple Key Controlled Audio Cassette Load and Dump
- Expansion Provision for Mounting Two S-100 Connectors (Sockets Not Included)
- Wire Wrap Area for Custom Circuitry
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- 2K Byte ZBUG Monitor in ROM
- 1K Bytes of RAM (Expandable to 2K Bytes)
- A 4 Channel Hardware Counter/Timer (Z80-CTC)
- Two Bi-Directional 8-Bit I/O Ports (Z80-P10)
- Up to 5 Programmable Breakpoints
- Switch Selectable PROM or Monitor Restart
- Vectored Interrupts provided by Z80-CTC and

Sale Price

SDS-Z80 STARTER KIT.....$219.00
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CC-3 Deluxe Padded Vinyl Carrying Case **$7.50**
VP-10 X10 DCV Probe Adapter/ Protector 10Kv **$14.95**
VP-40 40Kv DC Probe **$35.00**
CS-1 10 Amp Current Shunt **$14.95**

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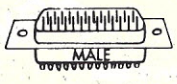
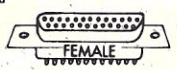
Just for Asking.
FREE BATTERY with your meter.

RS232 & "D" TYPE CONNECTORS *

P = Plug-Male S = Socket-Female C = Cover-Hood





PART NO.	DESCRIPTION	PRICE 1-4	5-9	10-24
DE-9P	9 Pin Male	1.50	1.30	1.20
DE-9S	9 Pin Female	2.15	2.05	1.95
DE-9C	9 Pin Cover	1.50	1.30	1.15
DA15P	15 Pin Male	2.20	2.00	1.80
DA15S	15 Pin Female	3.20	3.00	2.80
DA15C	15 Pin Cover	1.60	1.45	1.30
DB-25P	**25 Pin Male**	**2.90**	**2.60**	**2.50**
DB-25S	**25 Pin Female**	**3.75**	**3.65**	**3.40**
DB51212-1	**1 pc. Grey Hood**	**1.65**	**1.40**	**1.20**
DB1226-1A	**2 pc. Black Hood**	**1.90**	**1.80**	**1.50**
DB110963-3	**2 pc. Grey Hood**	**1.80**	**1.55**	**1.35**
DC37P	37 Pin Male	3.95	3.80	3.60
DC37S	37 Pin Female	5.75	5.50	5.20
DC37C	37 Pin Cover	2.20	1.95	1.75
DD50P	50 Pin Male	4.95	4.75	4.50
DD50S	50 Pin Female	7.50	7.20	6.90
DD50C	50 Pin Cover	2.50	2.20	2.10
D20418-S	Hardware Set (2 pair)	1.00	.80	.70

Connector for CENTRONICS 700 SERIES:
Amphenol 57-30360 for back of Centronics 700 Series printers
1-4—$9.00 5-up—$7.50

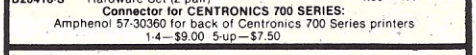
3 LEVEL GOLD WIRE WRAP SOCKETS*

Sockets purchased in multiples of 50 per type may be combined for best price.

	1-9	10-24	25-99	100-249	250-999
8 pin	.40	.36	.34	.31	.27
14 pin	.44	.43	.41	.39	.37
16 pin	.55	.47	.45	.41	.39
18 pin	.70	.60	.55	.50	.45
20 pin	.90	.80	.75	.65	.62
22 pin	.95	.85	.80	.70	.65
24 pin	.95	.85	.80	.70	.65
28 pin	1.25	1.15	1.00	.95	.90
40 pin	1.65	1.45	1.35	1.20	1.10

All sockets are GOLD 3 level closed entry. 2 level Tail Low Profile, Tin Sockets and Dip Plugs available. CALL FOR QUOTATION.

S-100 BUS EDGE CONNECTORS * SALE



S100-WWG 50/100 Cont .125 ctrs. 3 LEVEL WIRE WRAP .025" sq. posts on .250 spaced rows. GOLD PLATED

1-4	5-9	10-24
$4.75	$4.00	$3.75

S100-STG 50/100 Cont .125 ctrs. DIP SOLDER TAIL on 250 spaced rows for VECTOR, IMSAI, CROMENCO mother boards GOLD plated

1-4	5-9	10-24
$4.10	$3.80	$3.50

S100SE 50/100 Cont .125 ctrs. PIERCED SOLDER EYELET Tails GOLD

1-4	5-9	10-24
$5.00	$4.50	$4.00

S100ALT 50/100 Cont 125 ctrs. DIP SOLDER TAIL on 140 spaced rows for ALTAIR motherboards, GOLD plated.

1-4	5-9	10-24
$4.50	$4.25	$4.00

Other Popular Edge Connectors

D2244-5WW 22/44 Cont .156 ctrs.WIRE WRAP tails GOLD.

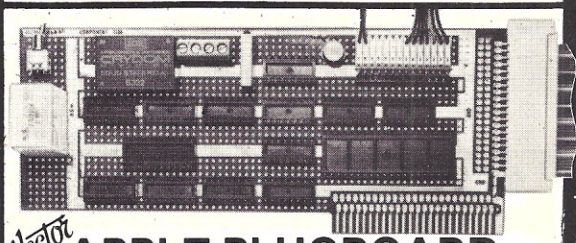
1-4	5-9	10-24
$3.95	$3.70	$3.40

D2244-5SE 22/44 Cont .156 Ctrs.PIERCED SOLDER EYELET tails GOLD plated.

1-4	5-9	10-24
$3.00	$2.60	$2.20

CG 1 (MSA) Style Card Guides 5/$1.00

See our July Ad for many other connectors.



Vector APPLE PLUGBOARD

Vector 4609 Peripheral Interface Plugboard for construction of custom circuits. Plug compatible with Apple II, Commodore PET and Super Kim microcomputers. Three connectors, in addition to the standard 25/50 system bus, are available for input/output. A 20/40-contact card-edge connector, fabricated on the rear of the board, mates with a 3-M type ribbon connector. Alternatively, a right-angle solder-tail header may be positioned in this same location. The Model 4609 also accomodates the miniature SIP-type connectors which may be placed on the periphery or in mid-board.

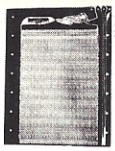
1-4	5-9	10-24
$21.50	$19.36	$17.26

7520 APPLE EXTENDER CARD $24.95

8803 MOTHER BOARD FOR S100 BUS MICRO-COMPUTERS

Vector

- Kit includes 12 tantalum capacitors for +5, +12, —12 buses and insulated mounting spacers.
- Wiring side shown. Component side bare epoxy glass with white markings for component locations.
- G10 epoxy glass board with 2 ounce copper, solder plated and .038 diameter holes for leads.
- Solder mask with solder windows on etched circuits to avoid accidental short circuits.
- Mounts 11 receptacles with 100 contacts (2 rows) on .125 centers with .250 row spacing, Vector part number R681-2; or mounts 10 receptacles plus interconnections to smaller mother board for expansion.
- Includes etched circuits and instructions for option of active, pull-up, or floating terminators.
- Large buses: +5V and GND (10 AMPS), ± 12V or 16V (7 AMPS). Current ratings are per MIL-STD-275 with 10ºC rise.
- Fits in Vector-pak enclosures.
- Fits in IMSAI 8080 microcomputer as expander board.



Price: $29.50

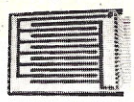
Vector Plugboards

8800V
Universal Microcomputer/processor plugboard, use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16"

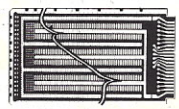
1-4	5-9	10-24
$19.95	$17.95	$15.96

8801-1
Same as 8800V except plain; less power buses & heat sink.

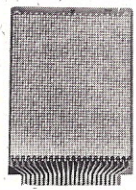
1-4	5-9	10-24
$15.22	$13.79	$12.18



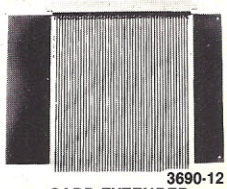
3682 9.6" x 4.5"
$12.97
3682-2 6.5" x 4.5"
$9.81
Hi-Density Dual-In-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156



3677 9.6" x 4.5'
$10.90
3677-2 6.5" x 4.5"
$9.74
Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin c n. spaced .156



3662 6.5" x 4.5"
$8.95
3662-2 9.6" x 4.5"
$11.45
P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced .156



3690-12 CARD EXTENDER
Card Extender has 100 contacts 50 per side on .125 centers-Attached connector-is compatible with S-100 Bus Systems. **$25.83**
3690 6.5" 22/44 pin .156 ctrs. Extenders $13.17

1/16 Vector BOARD .042 dia holes on 0.1 spacing for IC's

Phenolic PART NO.	SIZE	PRICE 1-9	10-19
64P44XXXP	4.5x6.5"	$1.56	$1.40
169P44XXXP	4.5x17"	$3.69	$3.32
Epoxy Glass			
64P44	4.5x6.5"	$1.79	$1.61
84P44	4.5x8.5"	$2.21	$1.99
169P44	4.5x17"	$4.52	$4.07
169P84	8.5x17"	$8.83	$7.95

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1,000's SETS SOLD! **4116's RAMS** 100% GUARANTEED
from Leading Manufacturers
(16Kx1 200/250ns)

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Add $3.00 for programming Jumpers for TRS-80 Keyboard

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Part No.	Sides/ Density	Sectoring	Price Box of 10
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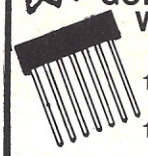
740/2-OP	2/single	Soft-IBM	$75.00
740-32P	1/single	32	$39.95
740/2-32P	2/single	32	$75.00
741-0	1/double	Soft	$59.00
		5"	
744-OK	1/single	Soft-(TRS-80)	$51.00*
744-10K	1/single	Soft/10	$51.00*
744-16K	1/single	Soft/16	$51.00*

*Price includes Kas-ette/10 Storage Box a $5.00 Value (TRS-80)
"DON'T SETTLE FOR ANYTHING LESS THAN SCOTCH"

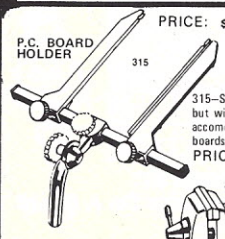
WOW!



14 & 16 PIN GOLD 3 LEVEL WIRE WRAP SOCKES*

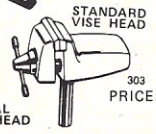
14 - G3 100 for **$36.00**
16 - G3 100 for **$37.00**
50 of each for **$38.00**

PANAVISE



PRICE: $18.98

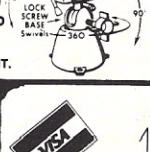
315—S same as 315 but with 14" bar to accomodate "S100" boards.
PRICE $19.98



PRICE: $14.49

PRICE: $14.49

PANAVISE TILTS, TURNS, AND ROTATES TO ANY POSITION. IT HOLDS YOUR WORK EXACTLY WHERE YOU WANT IT.



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PRICE: $13.49

10% OFF BEFORE X-MAS

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2114-3L 1Kx4 300 ns Low Power	8/$50.00
5257-3L 4Kx1 300ns Low Power	8/$50.00
2708 8K 450ns EPROM	8/65.00 $9.00
2716 16K 5 Volt Only EPROM	$40.00

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Perfectly balanced fluorescent lighting with precision magnifier lens. Tough thermoplastic shade. Easy lens removal. New wire clip design permits easy installation and removal of fluorescent tube. Comes with plastic shield to protect tube from soiling and damage.
Colors: Gray, Black, and Chocolate Brown. Comes with one 22 watt T-9 Circline fluorescent tube. 3 diopter lens.

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Vector
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for .042 dia. holes
(all boards on this page)
T44/C pkg. 100 .. **$ 2.34**
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A-13 hand installing tool ..... **$ 4.19**

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ATTENTION ELF OWNERS: QUEST SUPER BASIC

Quest, the leader in inexpensive 1802 systems announces another first. Quest is the first company worldwide to ship a full size *Basic* for 1802 systems. A complete function Super Basic by Ron Cenker including floating point capability with scientific notation (number range ±.17E^{38}), 32 bit integer ±2 billion, Multi dim arrays, String arrays, String manipulation, Cassette I/O, Save and load, Basic, Data and machine language programs and over 75 Statements, Functions and Operators.

Easily adaptable on most 1802 systems. Requires 12K RAM minimum for Basic and user programs. Cassette version in stock now. ROM versions coming soon with exchange privilege allowing some credit for cassette version.

Super Basic on Cassette $40.00

Tom Pittman's 1802 Tiny Basic Source listing now available. Find out how Tom Pittman wrote Tiny Basic and how to get the most out of it. Never offered before. $19.00

S-100 Slot Expansion $9.95

Coming Soon: Assembler and Editor; Elf II Adapter Board. High resolution alpha/numerics with color graphics expandable up to 256 x 192 resolution for less than **$100.**

16K Dynam. RAM bd. expand. 32K; less than $150.

RCA Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded** with **additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** Expansion Cabinet with room for 4 S-100 boards **$41.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic Cassette **$10.00,** on ROM **$38.00,** original Elf kit board **$14.95. 1802 software;** Moews Video Graphics **$3.50.** Games and Music **$3.00,** Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatible cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50.** A **50 pin connector set** with ribbon cable is available at $12.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply below).

INTEGRATED CIRCUITS

7400TTL

7400N	.17	74S20N	.35
7402N	.18	74S22N	.35
7404N	.19	74S28N	.41
7409N	.23	74S30N	.35
7410N	.18	74S33N	.75
7414N	.70	74S38N	.55
7420N	.18	74S74N	1.25
7422N	.39	74S75N	1.00
7430N	.20	74S90N	.85
7442N	.50	74S93N	.70
7445N	.69	74S95N	1.10
7447N	.60	74S107N	.45
7448N	.69	74LS112N	.45
7450N	.18	74LS113N	.35
7474N	.35	74LS132N	.89
7475N	.49	74LS136N	.45
7485N	.88	74LS151N	.85
7489N	1.85	74LS155N	.85
7490N	.43	74LS157N	.85
7492N	.43	74LS162N	1.15
7493N	.43	74LS163N	1.15
7495N	.69	74LS174N	2.00
74100N	.90	74LS190N	1.06
74107N	.35	74LS221N	1.95
74121N	.34	74LS258N	.67
74123N	.59	74LS367N	1.35
74125N	.45		
74145N	.69	**LINEAR**	
74150N	.95	CA3045	.90
74151N	.69	CA3046	1.10
74154N	1.00	CA3081	1.80
74157N	.69	CA3082	1.90
74161N	.87	CA3089	2.95
74162N	.87	LM301AN/AH	1.35
74163N	.87	LM305H	.87
74174N	.96	LM307N	.35
74175N	.90	LM308N	.89
74190N	1.15	LM309K	1.50
74192N	.87	LM311H/N	.90
74193N	.85	LM317T/K	3.75
74221N	2.00	LM318	1.35
74298N	1.65		
74365N	.66		
74366N	.66		
74367N	.66		

74LS00 TTL

74LS02N	.35
74LS04N	.35
74LS05N	.35
74LS08N	.35
74LS10N	.35
74LS13N	.55
74LS14N	1.10
74LS20N	.35
74LS22N	.35
74LS27N	.35
74LS30N	.35
74LS33N	.75
74LS38N	.55
74LS74N	1.25
74LS75N	1.00
74LS90N	.85
74LS93N	.70
74LS95N	1.10
74LS107N	.45
74LS112N	.45
74LS113N	.35
74LS132N	.89
74LS136N	.45
74LS151N	.85
74LS155N	.85
74LS157N	.85
74LS162N	1.15
74LS163N	1.15
74LS174N	2.00
74LS190N	1.06
74LS221N	1.95
74LS258N	.67
74LS367N	1.35

A to D CONVERTER

8038B	4.50
8700CJ	13.95
8701CN	22.50
8750CJ	13.95
LD130	9.95
9400CJV/F	7.40
ICL7103	9.50
ICL7107	14.25

CMOS

CD34001 Fair	.50
CD4000	.16
CD4001	.28
CD4002	.28
CD4006	1.10
CD4007	.28
CD4008	.28
CD4009	.45
CD4010	.45
CD4011	.28
CD4012	.28
CD4013	.39
CD4014	1.00
CD4015	1.00
CD4016	.45
CD4017	1.05
CD4018	.94
CD4019	.45
CD4020	1.02
CD4021	1.25
CD4022	1.10
CD4023	.28
CD4024	.75
CD4025	.28
CD4026	2.00
CD4027	.66
CD4028	.85
CD4029	1.02
CD4030	.45
CD4035	1.02
CD4040	1.02
CD4042	.85
CD4043	.85
CD4044	.85
CD4046	1.67
CD4049	.45
CD4050	.49
CD4051	1.13
CD4060	1.42
CD4066	.71
CD4068	.40
CD4069	.40
CD4070	.50
CD4071	.28
CD4072	.28
CD4073	.28
CD4075	.28
CD4076	1.45
CD4078	.40
CD4081	.28
CD4082	.28
CD4116	.47
CD4490	5.50
CD4507	1.00
CD4508	4.25
CD4510	1.02
CD4511	.94
CD4515	2.52
CD4516	1.10
CD4518	1.02
CD4520	1.02
CD4527	1.51
CD4528	.79
CD4553	3.50
CD4566	2.25
CD4583	4.50
CD4585	1.10
CD40192	3.00
74C00	.28
74C04	.40
74C10	.28
74C14	2.10
74C20	.28
74C30	.28
74C48	1.95
74C74	.75
74C76	1.40
74C90	1.15
74C93	1.40
74C154	3.00
74C160	1.44
74C175	1.35
74C192	1.65
74C221	2.00
74C905	6.00
74C906	.75
74C914	1.95
74C922	5.50
74C923	5.50
74C925	6.95
74C926	6.95
74C927	6.95

INTERFACE

8095	.65
8096	.65
8097	.65
8098	.65
8T09	1.25
8T10	4.50
8T13	3.00
8T20	5.50
8T23	3.10
8T24	3.50
8T25	3.20
8T26	1.69
8T28	2.75
8T97	1.69
8T98	1.69

MOS/MEMORY

RAM

2101-1	3.95
2102-1	.95
2102AL-4	1.25
2102AN-2L	1.60
21L02-1	1.18
21L02-1	1.18
21F02	1.25
2104A-4	4.95
2107B-4	3.75
2111-1	3.75
2112-2	3.95
2114L-1	7.40
2114L-3	7.90
4116	10.95
2513B	6.30
MM5262	.40
MM5280	3.00
MM5320	9.95
MM5330	5.94
PD411D-3	4.00
PD411D-4	5.00
P5101L	13.95
4200A	9.95
82S25	2.90
91L02A	1.50
HD0165-5	6.95
MM57100	4.50
GIAY38500-1	9.95
MCM6571A	9.95
9368	3.50
410D	10.00
416	16.00

CLOCKS

MM5314	3.90
MM5315	4.00
MM5369	2.10
MM5841	14.45
MM5865	7.95
CT7001	5.80
CT7010	8.95
CT7015	7.25
MM5375AA/N	3.90
MM5375AG/N	4.90
7205	16.50
7207	7.50
7208	15.95
7209	4.95
DS0026CN	3.75
DS0056CN	3.75
MM53104	2.50

MICROPROCESSOR

6800	17.50
6802	18.75
8080A	8.95
8085	27.00
Z80	14.75
Z80A	19.75
8212	2.90
8214	8.00
8216	2.90
8224	2.90
8228	5.35
8251	8.50
8253	15.00
8255	9.25
8257	19.50
8259	19.50
1802CP	
plas.	13.95
1802DP	
plas.	17.95
1861P	11.50
CDP1802CD	19.95
CDP1802D	25.00
CDP1861	12.95
6820	9.95
6850	12.95
6502	12.50
6504	16.50
6522	13.60

UART/FIFO

AY5-1013	5.50
AY5-1014	7.50
3341	6.95

PROM

1702A	3.95
2708	10.50
2716T1	29.50
2716 Intel	48.00
2732	115.00
2758	22.50
8741A	85.00
8748	75.00
8748-8	60.00
8755A	65.00
N82S23	2.95
N82S123	3.50
N82S126	3.75
N82S129	3.75
N82S131	3.75
N82S136	8.75
N82S137	8.75
DM8577	2.90
8223	2.90

CONNECTORS

30 pin edge	2.50
44 pin edge	2.75
100 pin edge	4.50
100 pin edge WW	5.25

IC SOCKETS

Solder Tin		Low Profile	
PIN	1 UP	PIN	1UP
8	.15	22	.30
14	.14	24	.35
16	.16	28	.42
18	.27	36	.58
20	.29	40	.57

2 level 14 pin ww .20

WIRE WRAP LEVEL 3

PIN		PIN	
14	.32	24	.86
16	.33	28	1.00
18	.57	40	1.23

CRYSTALS

1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
18 MHz	3.90
20 MHz	3.90
32 MHz	3.90
32768 MHz	4.00
1.8432 MHz	4.50
3.5795 MHz	1.20
2.0100 MHz	1.95
2.097152 MHz	4.50
2.4576 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
5.7143 MHz	4.50
6.5536 MHz	4.50
14.31818 MHz	4.25
18.432 MHz	4.50
22.1184 MHz	4.50

KEYBOARD ENCODERS

AY5-2376	$12.50
AY5-3600	17.95
74C922	5.50
74C923	5.50
HD0165-5	6.95

D Connectors RS232

DB25P	2.95
DB25S	3.95
Cover	1.50
RS232 Complete Set	6.50
DE9S	1.95
DA15P	2.10
DA15S	3.10

TRANSISTORS

2N1893	.40
2N222A	.27
2N2369	.30
2N2904A	.20
2N2907A	.25
2N3053	.40
2N3638	.25
2N3643	.25
2N3904	.18
2N3906	.18
2N3055	.69
2N4400	.25
2N4401	.25
2N4402	.20
TIP31	.60
TIP33A	1.00

RESISTORS ¼ watt 5%

10 per type .03 1000 per type .012
25 per type .025 350 piece pack
100 per type .015 5 per type 6.75
½ watt 5% per type .05

KEYBOARDS

56 key ASCII keyboard kit	$67.50
Fully assembled	77.50
53 key ASCII keyboard kit	60.00
Fully assembled 70.00 Enclosure	14.95

LEDS

Red T018	.15
Green, Yellow T018	.20
Jumbo Red	.20
Green, Orange, Yellow Jumbo	.25
Cliplite LED Mounting Clips	8/$1.25

(specify red, amber, green, yellow, clear)

CONTINENTAL SPECIALITIES in stock
Complete line of breadboard test equip.
MAX-100 8 digit Freq. Ctr. $128.95

OK WIRE WRAP TOOLS in stock
Portable Multimeter $18.00

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MM5865 Stopwatch Timer	9.00
PC board	7.50
Switches Mom. Pushbutton	.27
3 pos. slide	.25
Encoder HD0165-5	6.95
3 Digit Universal Counter Board Kit	
Operates 5–18 Volt DC to 5 MHz typ. .125" LED display	**10.50**
Paratronics 100A Logic Analyzer Kit	**$224.00**
Model 10 Trigger Expander Kit	$229.00
Model 150 Bus Grabber Kit	$369.00
Sinclair 3½ Digit Multimeter	**$59.95**
Clock Calendar Kit	**$23.95**
2.5 MHz Frequency Counter Kit	**$37.50**
30 MHz Frequency Counter Kit	**$47.75**

TRANSFORMERS

6V 300 ma	3.25
12 Volt 300 ma transformer	1.25
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12V CT 250 ma wall plug	3.50
24V CT 400 ma	3.95
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12V 6 amp	12.95
12V 500 ma wall plug	4.75
12V 1 amp wall plug	6.50
12V 3 amp wall plug	8.50

DISPLAY LEDS

MAN1	CA	.270	2.90
MAN3	CC	.125	.39
MAN72/74	CA/CA	.300	1.00
DL704	CC	.300	1.25
DL707/DL707R	CA	.300	1.00
DL727/728	CA/CC	.500	1.90
DL747/750	CA/CC	.600	1.95
DL750	CC	.600	1.95
FND359	CC	.357	.70
FND500/507	CC/CA	.500	1.35
FND503/510	CC/CA	.500	.90
FND800/807	CC/CA	.800	2.20
3 digit Bubble			.60
4 digit Bubble			.80
DGB Fluorescent			1.75
DG10 Fluorescent			1.75
5 digit 14 pin display			1.00
NSN69 9 digit display			.60
7520 Clairex photocells			.39
TIL311 Hex			9.50
MAN3640	CC	.30	1.10
MAN4610	CA	.40	1.20
MAN4640	CC	.40	1.20
MAN4710	CA	.40	.95
MAN4740	CC	.40	1.20
MAN6640	CC	.56	2.95
MAN6710	CA	.60	1.35
MAN6740	CC	.60	1.35
MA1002A		**8.95**	
MA1012A		**8.95**	
102P3 transformer		**2.25**	

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. $375.00. 4K version $450.00. 4K Assembler $85.00, 8K Basic Interpreter $100.00. Power supply assy. in case $60.00. AIM 65 in thin briefcase with power supply $485.00.

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Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instructions. Orange displays also avail. **Same kit w/.80" displays.** Red only. **$21.95** Case **$11.75**

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Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

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16K Static RAM Kit	265.00
24K Static RAM Kit	423.00
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32K Static RAM Kit	**$475.00**
64K Dynamic RAM Kit	470.00
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Motherboard **$39.**	Extender Board **$8.99**

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DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instructs. Add $3.95 for beautiful dark gray case. Best value anywhere.

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Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

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Will erase 25 PROMs in 15 minutes. Ultraviolet, assembled **$34.50**

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Batt/AC oper. 0.1mv–1000v. 5 ranges. 0.5% accur. Resistance 6 low power ranges 0.1 ohm–20M ohm. DC curr. .01 to 100ma. Hand held, ½" LCD displays, auto zero, polarity, overrange. **$69.95.**

Digital Temp. Meter Kit $34.00

Indoor and outdoor. Switches back and forth. Beautiful. 50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure −100° to +200°F, tenths of a degree, air or liquid. Beautiful woodgrain case w/bezel **$11.75**

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60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, IC, crystal, resistors, capacitors and trimmer.

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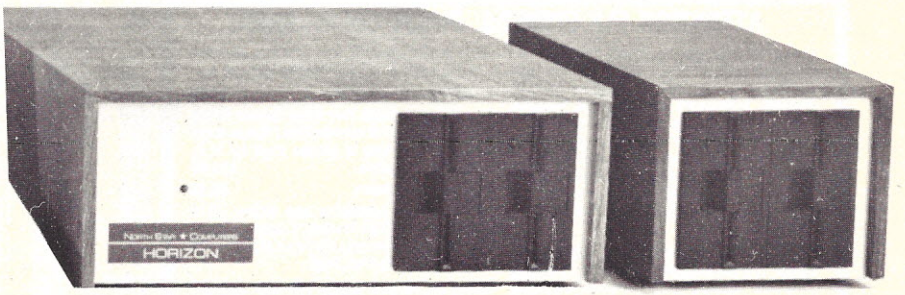
1.4 megabyte computer system —

Now double density or quad density (double headed, double sided minifloppy disk drive)



The NORTH STAR HORIZON® is a price-performance leader in S-100 systems. It features a 4 MHz CPU board and double-density disk controller board. All Horizons* now come with two serial RS232C ports, a parallel port, all 12 edge connectors, and an interface cable for connection to an external drive. Horizons are available as single-drive units (Horizon 1) or dual-drive units (Horizon 2). Drives can be double density or double-sided (quad density). A Horizon 2 with two external quad drives gives the user 1.4 megabytes of on-line storage. The Horizon comes with a DOS and North Star Extended Disk BASIC. A CP/M operating system is only $129.

Just add a terminal and you have a complete and extremely flexible computer system. For example, either the INTERTUBE II or Perkin-Elmer BANTAM 550 video terminals are only $799 additional from MiniMicroMart.

** A few 16K Horizons still available as low as $1349!*

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Assembled and Tested, List $2765 . . **2339**

32K, quad-density, Kit, List $2779 . . . . . **2359**
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Additional 16K RAM with parity
Kit (RAM-16A), List $399 . . . . . **$329**
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Intertec INTERTUBE II List $995 . . . **$799**
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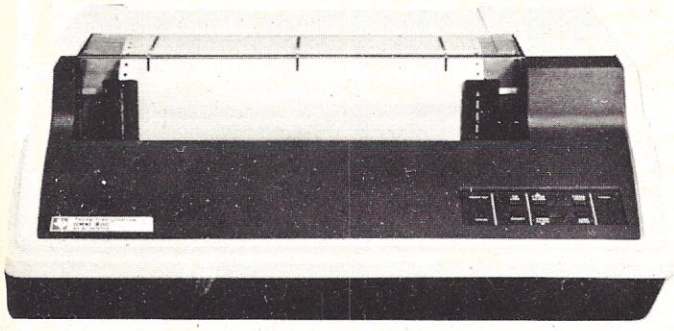

T.I. 810 PRINTER (basic unit)
with RS232 serial interface, List $1895 **$1695**
with RS232 serial and parallel interfaces **1735**

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List $995
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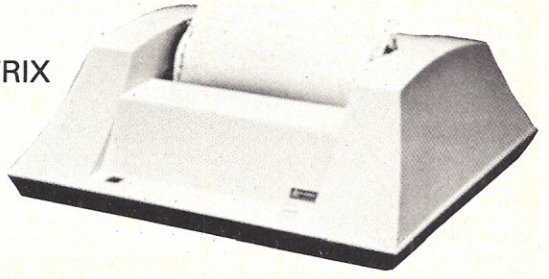

NOTE: Horizons may be ordered for future delivery with only 10% deposit.
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All prices are subject to change and offers are subject to withdrawal without notice. Credit card purchases are 2% higher.

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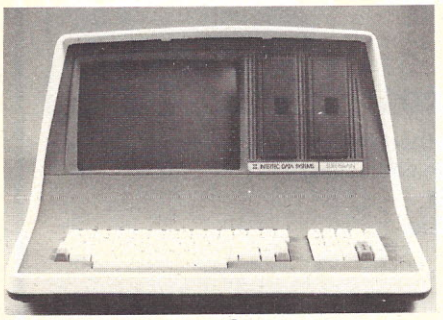

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Sells for well under $3,000!
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- Upper and lower case
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INTERTUBE II by Intertec

- 12" Display
- 24 x 80 format
- 18-key numeric keypad
- 128 upper/lower case ASCII characters
- Reverse video, blinking
- Complete cursor addressing and control
- Special user-defined control function keys
- Protected and unprotected fields
- Line insert/delete and character insert/delete editing
- Eleven special line drawing symbols

OUR PRICE $799

ANADEX 80-COLUMN DOT MATRIX PRINTER

Complete upper and lower case ASCII char. set, bi-directional at 84 lines/min. Features RS232 20/60 mil current loop and Centronix parallel interface. Ideal for use with TRS-80, Sorcerer, Cromemco, and North Star systems.

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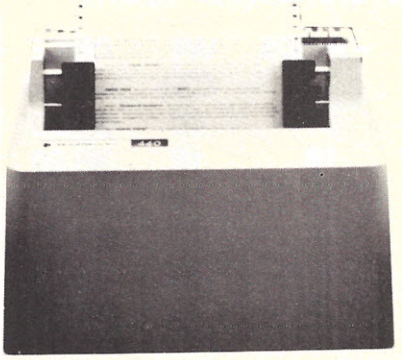

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IP-440 Basic Unit, List $995	**$895**
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* 1210 Option is expanded and compressed print

T.I. 810

Bi-directional
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Logic-Seeking
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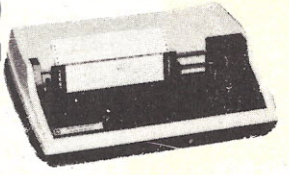

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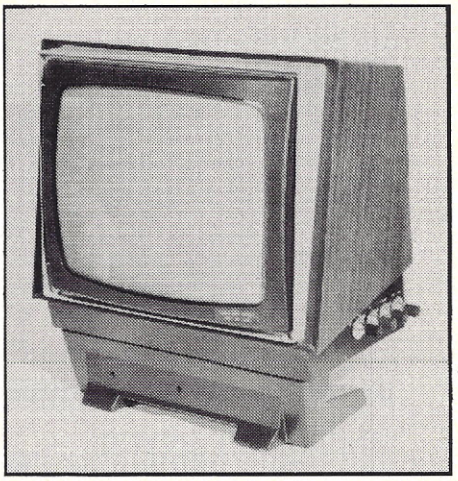

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12" black & white monitor. Wide band, will display 80 x 24 char. 10K or 75Ω input impedance, composite video input. Transformer power supply.
Shpt. Wt. 30#
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Used with all computers such as: TRS-80, Apple, and many others.
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51 key typewriter style keyboard, with case, not encoded. Single contact keys
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5' RG/59U cable with PL259 connector on one end.
Price: $1.00 ea. 6/$5.00

24" RG/59U cable with PL 259 connector on one end, BNC on other end.
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Microprocessor Chips #6502
Price: $6.00 ea. or 2/$10.00

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- Model 101A, 60 to 200 lines/minute
- 165 characters/second
- 132 characters/line
- 9 × 7 dot matrix pattern

All models feature fixed vertical/horizontal registration; remote select/deselect; elongate bold face characters (line by line); vertical format unit; two channel VFU; prints originals plus four copies; 8 bit ASCII parallel data input; paper runaway inhibit; audio alarm; printing methods include impact character by character one line at a time.

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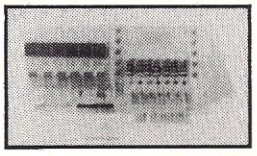

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6 digit numeric display boards with 6 FND 507. Common anode displays and 10 red LED's. With drivers & logic for multiplexed operation.
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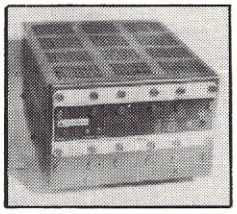

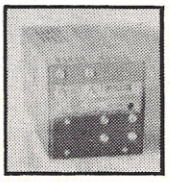

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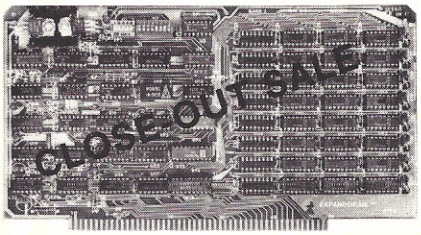
EXPANDORAM
EXPANDABLE TO 64K USING 4116 RAMS



Interfaces with most popular S-100 boards
Bank selectable; PHANTOM provision
Draws only 5 watts fully populated
Designed to work with Z-80, 8080,and 8085 systems
No wait states required
16K boundaries & protect via dip switches
Kits come with sockets for full 64K
Invisible refresh

MEM-16130K (16K KIT) **$199.00**
MEM-16130A (16K A&T) **$249.00**
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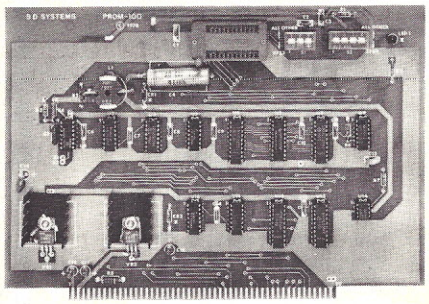
MEM-64133K (64K KIT) **$394.00**
MEM-64133A (64K A&T) **$444.00**

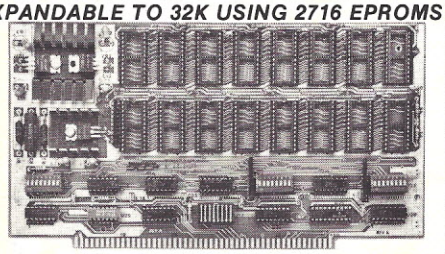
S D SYSTEMS
PROM-100
VERSATILE EPROM PROGRAMMER



S-100 bus compatible (note: board height 7")
Dip switch selects 2708, 2716, 2732, 2758, or 2516's
25 VDC programming pulse generated on board
Programming time only 100 seconds for 16K bits
Support-software listing provided in manual
Program and erasure verification
Software provides for reading of object file from CP/M and programming into EPROM

MEM-99520K (KIT) **$145.00**
MEM-99520A (A&T)..... **$215.00**

S D SYSTEMS
EXPANDOPROM
EXPANDABLE TO 32K USING 2716 EPROMS



S-100 bus compatible, uses 2708 or 2716 EPROMs
Dip switches allow selection of : each EPROM, 16K or 32K boundary, wait states

MEM-32220K (KIT) **$135.00**
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DOUBLE DENSITY DISK CONTROLLER

Read/write single or **double density,** 8" or 5¼"drives
On board Z-80 insures reliable operation
CP/M compatible in either single or double density
Density is software selectable
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All the hard work of disk access is done by the on board Z-80A and 2K memory, leaving your host CPU free for its normal duties
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THIS BOARD REALLY WORKS !!!!!!

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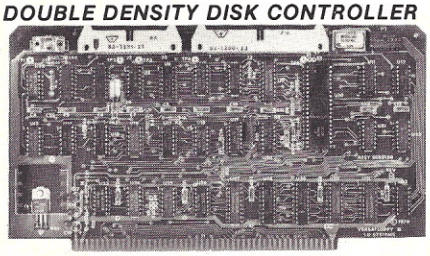
S D SYSTEMS
VERSAFLOPPY II
DOUBLE DENSITY DISK CONTROLLER



Single or double density floppy disk controller
985600 bytes on 8" double sided diskettes
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S-100 bus (IEEE) standard compatible
IBM 3740 format in single density
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Controls up to 4 drives
Vectored interrupt operation optional

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S D SYSTEMS
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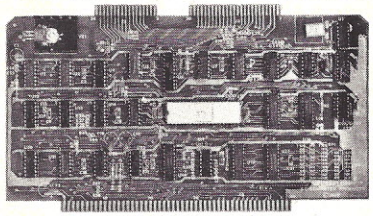
VERSATILE FLOPPY DISK CONTROLLER



IBM 3740 soft sectored format
S-100 Z-80 or 8080 compatible
Controls up to 4 single or double sided drives
Compatible with all popular disk drives
CP/M compatible
Listings for control software included

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Z-80 CPU BOARD WITH SERIAL I/O PORT

2 or 4 MHz switchable, on-board 2708, 2716, or 2732 EPROM useable in SHADOW mode (full 64K RAM)
Automatic MWRITE generation if no front panel
On-board USART for sync or async RS232

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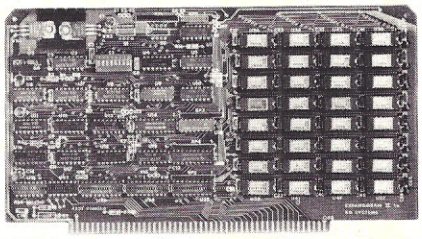
S D SYSTEMS
EXPANDORAM II
4 MHz RAM BOARD EXPANDABLE TO 256K



S-100 bus compatible, up to **4 MHz** operation
Expandable memory from 16K to 256K
Dip switch selectable boundaries
Page-mode allows up to 8 boards on the same bus
Invisible refresh; PHANTOM output disable
Designed to operate in Z-80 based systems

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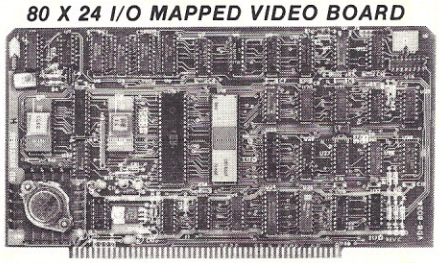
S D SYSTEMS
VDB-8024
80 X 24 I/O MAPPED VIDEO BOARD



80 character by 24 line display, 7 X 10 dot matrix
Composite or seperate TTL video outputs
On-board keyboard interface with power
On-board Z-80 and 2K RAM
Blink, underline, reverse, protect, up/down scroll
Upper/lower case characters, 32 special characters
Optional 128 user-programmable characters

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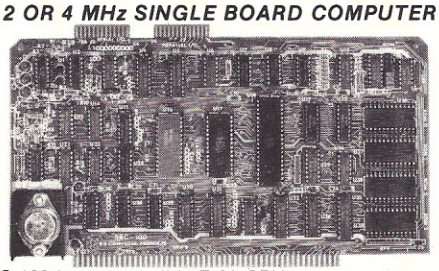
SBC-100/200
2 OR 4 MHz SINGLE BOARD COMPUTER



S-100 bus compatible Z-80 CPU
1K of on-board RAM
4 EPROM sockets accomodates 2708, 2716, or 2732
One parallel and one serial I/O port
4-channel counter timer chip (Z-80 CTC)
Software programmable serial baud rates

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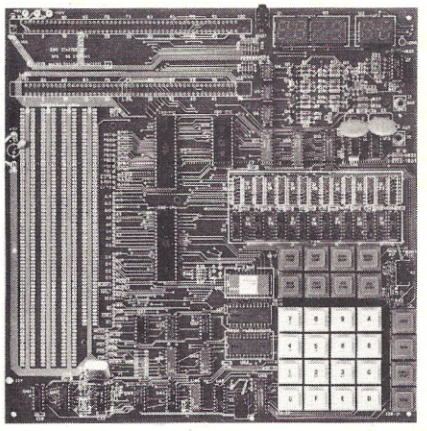
COMPLETE Z-80 MICROCOMPUTER



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On-board S-100 interface
Wire-wrap area and room for 2 S-100 connectors
Two 8-bit parallel I/O ports, 4-channel CTC, 5 programmable breakpoints
Examine and change memory, I/O ports, or register

CPS-30010K (KIT) **$219.00**
CPS-30010A (A&T) **$365.00**

CP/M 2.0

Digital Research has done it again! This new release of their industry standard disk operating system is bound to be an even bigger hit than the original version. All of the fundamental file-size restrictions of release 1 have been eliminated, while maintaining full compatibility with the earlier versions. This new release can be field-configured by the user for a single mini-disk up through a multiple drive hard-disk system with 128 megabyte capacity. Field configuration can be accomplished easily through use of the Macro Library (DISKDEF) provided with CP/M 2.0.

A powerful operating system for only ... $150.00

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TRS-80 APPLE EXIDY

Everything you need to add 16K of memory to your computer. Your kit comes neatly packaged with easy to follow instructions. In just minutes your computer is ready to tackle more advanced software.

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PARALLEL/SERIAL/INTERRUPT BOARD

Z-80 SIO/PIO, 2 CTCs, expands to 2 SIOs, 4 CTCs
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2 parallel ports **with full handshake**
Software baud rate generators, interval timers, counters, and generates 32 vectored interrupts
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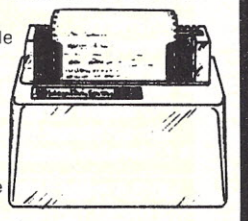

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Eight software selectable character sizes.
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SALE

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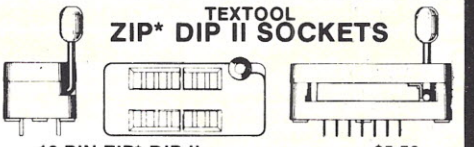

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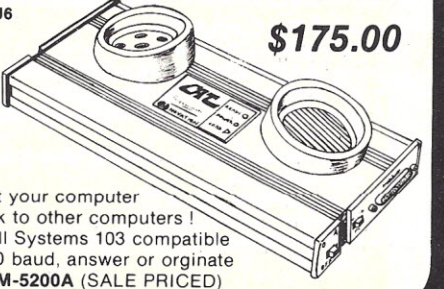

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- Bank Selectable
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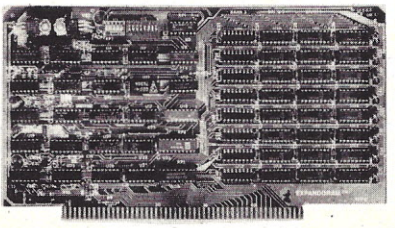
- Power 8VDC, +16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Major Brand 16K RAMS
- PC Board is doubled solder masked and has silk-screened parts layout
- Extensive documentation clearly written



- Complete kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required
- 16K boundaries and Protection, via Dip Switches
- Designed to work with Z-80, 8080, 8085 CPU's

EXPANDORAM 64K Kit (16K Ram)

WITHOUT MEMORY	**$139.00**
16K	**209.00**
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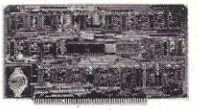
48K	**340.00**
64K	**405.00**

SD'S PROM 100 PROM Programmer Board

The PROM-100 Programmer is a development tool for S-100 Bus computer systems. The Zero Insertion Force Programming Socket extends above the card cage height for easy access to PROM devices. Software verifies PROM erasure, verifies program loading and provides for reading of object file from Disk or PROM and programming into PROM/EPROM. Features include: On-board generated 25vdc Programming pulse, TTL compatible, maximum programming time for 16,389 bits is 100 seconds. Programs: 2708, Intel 2758, 2716, 2732 and TI 2516. DIP Selectable EPROM type.

PROM-100 Board Kit $149.95

SD'S MPB-100 Z80 CPU BOARD KIT



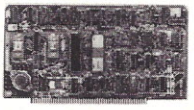
The MPB-100 provides a Z80 microprocessor based CPU for S-100 Bus systems. Front panel usage is optional, making the MPB-100 suitable for upgrading existing systems to Z80 level. A PROM socket is provided on-board which makes the MPB-100 adaptable to process control applications. Features include: Power-on Jump to 4K boundaries, 2 Megahertz or 4 Megahertz operation, optional wait states, on-board PROM socket.

MPB-100 KIT $199.00

SD'S VERSAFLOPPY II

• IBM 3740 Compatible Soft Sectored Format for Single Density Drives • Operates with Single and Dual Sided Drives, Single or Double Density Drives and 5" & 8" Drives — in any combination of four simultaneously • Drive Select and Side Select Circuitry • S-100 Bus Compatible • Vectored Interrupt Operation Optional • Phase Locked Loop Data Recovery Circuit • Operates with Z80 CPU's • Uses FD1791-1 Controller Chip • Ther Versafloppy II incorporates all the possible features of a flexible disk drive controller into one board. Capable of handling four drives simultaneously, combinations of any variety are possible, such as 5" single sided, 8" dual density dual sided, 5" dual density single sided. Most popular drives are controlled directly with the Versafloppy II. The operating system for the Versafloppy II is the extremely powerful SDOS available for SD Systems. Diagnostic and control software available to complete your disk system.

$290 KIT, $385.00 ASSEMBLED & TESTED



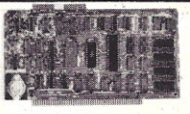
SD'S VDB-8024 VIDEO DISPLAY BOARD

The VDB-8024 features its own on-board Z80 microprocessor. This gives the capability of using software (included in ROM) to control functions and enhancements without interference with the computer's CPU. Included in the special features: 80 characters by 24 lines display, keyboard power and interface, composite and separate video output, 2K on-board RAM, a total of 256 available characters, full cursor control, forward and reverse scrolling, underlining, field reverse, field protect enhancements, programmable characters. **VDB-8024 KIT $289.00**

SD'S "VERSAFLOPPY I" KIT

FEATURES: IBM 3740 soft sectored compatible, S-100 BNS Compatible for Z-80 or 8080. Controls up to 4 drives (single or double sided). Directly controls the following drives: Sugart SA400/450 Mini Floppy • Shugart SA800/850 Standard Floppy • PERSCI 70 and 277 • MFE 700/750 • CDC 9404/9406

$135.00



SD'S SBC-100 SINGLE BOARD COMPUTER

The SBC-100 provides a complete micro-computer on a single board! The Z80 microprocessor is used as the heart of the SBC-100. The SBC-100 meets all the requirements of a Z80 CPU board with the added features of I/O ports, counter/timer channels, on board RAM, provisions for PROM/ROM and a software programmable baud rate generator. S-100 Bus compatible, the SBC-100 features are: 8K bytes of available PROM, 1024 bytes on-board RAM, Serial I/O with both synchronous and asynchronous operation, Parallel I/O ports, Operational Vectored Interrupts, and Four Counter/Timer Channels. SD Monitor available for RS-232 and Video Terminals. Disk based system software also available.

SBC-100 KIT $209.00

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Z80	$10.99

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2708	**$7.99**
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1771	$29.95
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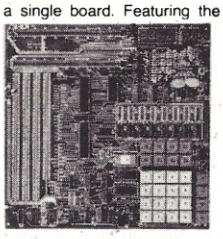
IC SOCKETS

SOLDER TIN PIN		LOW PROFILE PIN	
8	.12	16	.17
14	.15	18	.24
24	.32	40	.54
28	.39	20	.26

Z80 STARTER KIT

Kit: $219.95 Assembled & Tested $369.95

SD System's Z80 Starter Kit enables the novice to build a complete microcomputer on a single board. Featuring the powerful Z80 microprocessor, the Z80 Starter Kit features • Keyboard and Display • Audio Interface • PROM Programmer • Expansion and Wire Wrap Area • On Board RAM • 4 Channel Counter/Timer • Z-BUG Monitor in PROM • I/O Ports.



DIP SWITCHES

3 Pos.	**$1.10**
4 Pos.	**$1.12**
5 Pos.	**$1.16**
6 Pos.	**$1.20**
7 Pos.	**$1.22**
8 Pos.	**$1.26**
9 Pos.	**$1.36**
10 Pos.	**$1.30**

LEDS AND READOUT

Jumbo Red LED's	**8/1.00**
Jumbo Green LED's	**4/.95**
Jumbo Yellow LED's	**4/.95**
Jumbo Amber LED's	**4/.95**
MV Red	**10/1.00**
FND 70CC	**.50**
DL 707	**.95**
DL 747CA	.65
DL 728CC	**1.19**
FND 800CC	**1.50**
Red Filter 4" Bezel	**2.50**
Green Filter 4" Bezel	**2.50**
Amber Filter 4" Bezel	**2.50**
4N25	**1.60**
4N26	**1.25**
4N27	**1.10**
4N28	**.95**
4N31	**1.20**

S-100 CONNECTORS

High-Quality Gold Pins

$2.99 EACH

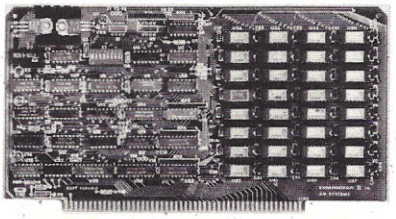
FLOPPY DISK SPECIAL

5.25" SOFT, 10 OR 16 SECTOR
10 FOR $29.95
8" SOFT SECTORED IBM COMPATIBLE
10 FOR $34.95

SD'S EXPANDORAM II

The Randem Access Memory

- S-100 Bus Compatible
- Up to 4Mhz Operation
- Expandable Memory from 16K to 256K
- DIP Switch Selectable Boundaries
- Uses 16K (4116) or 64K (4164) Memory Devices
- Page Mode Operation Allows up to 8 Memory Boards on Bus
- Operates with Z80 CPU's
- Phantom Output Disable
- Invisible Refresh (Synchronized with Wait States)



SD Systems' ExpandoRAM II is a dynamic RAM board with capacities from 16K bytes (4116) to 256K bytes (4164). It operates on the industry S-100 Bus. The design allows 8 boards to operate from the same S-100 Bus. The ExpandoRAM II is compatible with most S-100 CPU's based on the Z80 microprocessor.

EXPANDORAM II KIT

W/O	**$195.00**
16K	**285.00**
32K	**375.00**
48K	**465.00**
64K	**555.00**

HOLIDAY SPECIALS For Orders Received BEFORE December 31, 1979

Power Supplies! Power Supplies! Power Supplies! SOLID STATE!! (5)

We got 'em! Take your pick...

These units are ideal for micro computers. They have been removed from equipment, checked out and guaranteed.

1—5 volts @ 8 amps + 12 volts @ 2 amps + 6 volts @ 75 MA. Power supply has a 3-wire line cord and fused. Dimensions: 10½" × 5½" × 4½". Shipping weight: 16 lbs.. ..... 37.50 ea. 2/70.00

2—Model 818, 5 volts at 15 amps + 12 volts at 4 amps–12 volts at 2 amps. (with line cord). ..... 35.00 ea. 2/65.00

3— + 5 volts at 5 amps ± 12 volts at 500 ma. + 6 volts at 25 ma. (line cord included).. ..... 32.95 ea. 2/60.00

4—Elexon, multi output. Input: 120/240 AC, ±10%, 47-63 hz; output: 1) 12V, 1.5A, DC, OVP; 2) 12V, 1.5A, D.C., OVP. New, in box with operating instructions. 31.50

5—Power Design, Model 1210, constant voltage, DC. P.S. input: 105-125. A.C., 55 to 440 hz. Output: 1-12 volts, 0-10 amps, DC. continuously adjustable output voltage and current limiting..... 139.00

COMPUTER GRADE CAPACITORS . . .

18,000 mfd 10 VDC	1.25	11,000 mfd 25 VDC	1.50	4,000 mfd 75 VDC	1.75
4,400 mfd 20 VDC	1.00	35,000 mfd 35 VDC	3.50	1,000 mfd 100 VDC	1.00
46,000 mfd 20 VDC	2.50	10,000 mfd 50 VDC	2.50	6,800 mfd 100 VDC	3.50
3,000 mfd 25 VDC	1.00	22,000 mfd 60 VDC	3.75	4,700 mfd 150 VDC	3.75

WIRE WRAP BOARDS

These boards have been removed from equipment. They're prewired, and very easy to unwrap for setting up your own boards. Contains mostly 14-pin IC sockets with individual connections. Each board has VCC and ground planes.

Smaller board measures 6½"x6" and has 40 to 50 sockets. **Reduced Price . . . $7.50 ea. 2/$14.00**

Larger board measures 13½"x6" and has 75 to 100 sockets. **Reduced Price . . . $12.50 ea. 2/$23.00**

DIABLO System Disc Drive

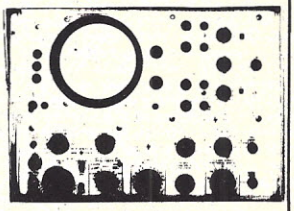
SERIES 40, MODEL 43

100 tracks per inch, total capacity of 50 megabits, w/Model 429 power supply, sector counter, 24 sectors, 1 fixed disc, 1 removable disc, average access time 38 ms, PPM: 2400, dimensions: 10 5/16" high, fits in standard rack, equipped with full extension slides, excellent used condition. Shipped freight collect.

$2495

HEWLETT-PACKARD MODEL 175A OSCILLOSCOPES

THESE SCOPES HAVE A 50 MHZ BANDWIDTH AND HAVE 2 PLUG-INS, A 1781B DELAY GENERATOR AND A MODEL 1755A DUAL TRACE VERTICAL AMPLIFIER. DIMENSIONS: 13" × 17" × 25", WEIGHT 71 LBS, SHIPPED FREIGHT COLLECT. 5" CRT. USED. CHECKED OUT AND OPERATING.



$339

TRANSFORMERS

ISOLATION STEP-DOWN TYPE

Primary: 230/115V, 50/60 CPS, Secondary: 115 volts output 250 VA.

$13.95 EACH

ROTRON WHISPER FANS

Unused, Model Rotron MU 3A1, 230V, AC, 14 watts, 50/60 hz, guaranteed, 4½"x4½"x1½"

$8.95

Clock Crystal Oscillators--TTL, Vectron, type CO-231T. Crystal freq. 4.9152 mhz. Input voltage 5 VDC ±. Output: Drives 10 TTL Loads Logic "0": 0.4V max., sink 16ma. Logic "1" 2.4V min source 2 ma. (above 50 mhz drives 2 Schottky TTL loads). Tuning adjust. with nominal range of ±30 ppm below 25 mhz and 15 ppm above 25 mhz. R.F.E. 1½"x1½"x½". $13.95

SG-132 SWEEP SIGNAL GENERATOR

FREQ: 15 TO 400 MHZ, VHF-UHF

Output: AM & FM. CW. FM deviation: ± 1% to ± 20% at any frequency. Crystal markers every 200Khz, 1mhz, 5mhz or ± 10B. Frequency accuracy ±1%. Built-in oscilloscope for observing waveforms.

$329

TRENDLINE PHONES

Manufactured by I.T.T.

These units have rotary dials. Colors are: white, black, red, and green. They are packaged and have 6-foot cord and installation instrructions. Used, but in good operating condition.

34.50 WALL TYPE

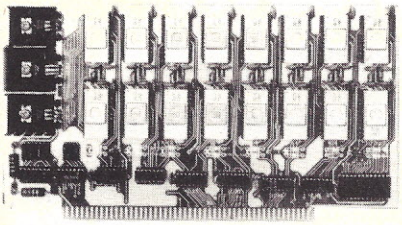
Minimum order $25.00. Items offered subject to prior sale. FOB, Brockton, Mass. Money order or check w/order. Shipments and handling add 5%. Shipments by parcel post or UPS. No CODs. Mass. residents add 5% sales tax.

WALLEN ELECTRONICS CO. INC. Tel: (617) 588-6440-6441
108 SAWTELL AVE., BROCKTON, MA. 02402

ELECTRONIC COMPONENTS
TEST EQUIPMENT
CONNECTORS -- WIRE

✓ Reader Service—see page 227

16K EPROM CARD-S 100 BUSS



$59.95 KIT

OUR BEST SELLING KIT!

USES 2708's!

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. All parts (except 2708's) are included. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

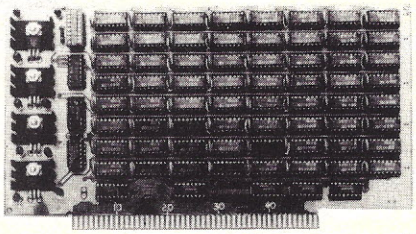
OUR 450NS 2708'S ARE $8.95 EA. WITH PURCHASE OF KIT

ASSEMBLED AND FULLY TESTED ADD $25

8K LOW POWER RAM KIT-S 100 BUSS

SALE

PRICE CUT!



$119.50 KIT

(450 NS RAMS!)

Thousands of computer systems rely on this rugged, work horse, RAM board. Designed for error-free, NO HASSLE, systems use.

KIT FEATURES:

1. Doubled sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included.
3. Fully buffered on all address and data lines.
4. Phantom is jumper selectable to pin 67.
5. FOUR 7805 regulators are provided on card.

Blank PC Board w/Documentation **$29.95**
Low Profile Socket Set...**13.50**
Support IC's (TTL & Regulators) **$9.75**
Bypass CAP's (Disc & Tantalums) **$4.50**

ASSEMBLED AND FULLY BURNED IN ADD $30

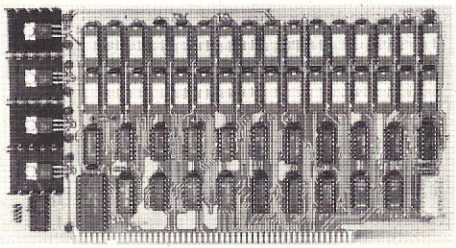
16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$279 KIT

FOR 250NS ADD $10

FULLY STATIC, AT DYNAMIC PRICES



WHY THE 2114 RAM CHIP?

We feel the 2114 will be the next industry standard RAM chip (like the 2102 was). This means price, availability, and quality will all be good! Next, the 2114 is FULLY STATIC! We feel this is the **ONLY** way to go on the S-100 Buss! We've all heard the HORROR stories about some Dynamic Ram Boards having trouble with DMA and FLOPPY DISC DRIVES. Who needs these kinds of problems? And finally, even among other 4K Static RAM's the 2114 stands out! Not all 4K static Rams are created equal! Some of the other 4K's have **clocked** chip enable lines and various timing windows **just as critical** as Dynamic RAM's. Some of our competitor's 16K boards use these "tricky" devices. But not us! The 2114 is the ONLY logical choice for a trouble-free, straightforward design.

KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 2 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

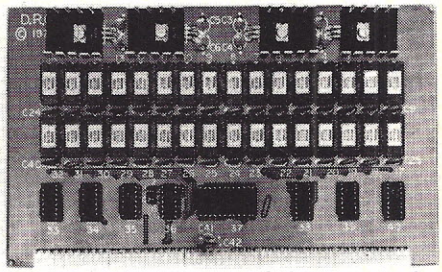
BLANK PC BOARD W/DATA—**$33**
LOW PROFILE SOCKET SET—**$12** ASSEMBLED & TESTED—**ADD $30**
SUPPORT IC'S & CAPS—**$19.95**

16K STATIC RAM SS-50 BUSS

PRICE CUT!

$275 KIT

FULLY STATIC AT DYNAMIC PRICES



KIT FEATURES:

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board. Solder mask and silk screened layout. Gold fingers.
5. All Parts and Sockets included
6. Low Power: Under 2 Amps Typical

FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $30

BLANK PC BOARD—**$33** COMPLETE SOCKET SET—**$12**
SUPPORT IC'S AND CAPS—**$19.95**

S-100 Z80 CPU CARD

ASSEMBLED AND TESTED! READY TO USE! Over 3 years of design efforts were required to produce a **TRUE** S-100 Z80 CPU at a genuinely bargain price! **4 MHZ!** **$159.95**

FEATURES:
- ★ 2 or 4 MHZ Operation.
- ★ Generates MWRITE, so no front panel required.
- ★ Jump on reset capability
- ★ 8080 Signals emulated for S-100 compatability.
- ★ Top Quality PCB, Silk Screened, Solder Masked, Gold Plated Contact Fingers.

Perfect For OEM's

LOW POWER - 250NS 2114 RAM SALE!

4K STATIC RAM'S. MAJOR BRAND, NEW PARTS. These are the most sought after 2114's, LOW POWER and 250NS FAST.

SPECIAL SALE: **$7.50 ea. or 8 For $55**
(We reserve the right to limit quantities.)

PROC. TECH. QUITS THE MICROPROCESSOR BUSINESS!
FACTORY CLOSE OUT - SPECIAL PURCHASE!
#16KRA

16K S-100 Dynamic Ram Board - $149.95

ORIGINALLY PRICED AT $429 each!

We purchased the remaining inventory of PT's popular 16K Ram Board when they recently closed their plant. Don't miss the boat! These are brand new, fully tested, ASSEMBLED and ready to go. All are sold with our standard 90 day limited warranty!!

72 Page Full Manual, Included Free!

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TERMS: Add $1.00 postage, we pay balance. Orders under $15 add 75¢ handling. No C.O.D. We accept Visa, MasterCharge, and American Express cards. Tex. Res. add 5% Tax. Foreign orders except Canada add 20% P & H. 90 Day Money Back Guarantee on all items.

10-DAY FREE TRIAL

Send for our FREE Catalog

$100 FREE ACCESSORIES WITH 16K or 32K PET

When you buy a 16K or 32K PET, apply $100 toward PET accessories, FREE. Just indicate on your order that you have reduced the cost of your accessories by $100.

FREE SAVE $69 **Terminal Package with 8K PETs**
See Special Below

8K-Keyboard N	$795
16K-Keyboard B	$995
16K-Keyboard N	$995
32K-Keyboard C	1,295
32K-Keyboard B	$1,295
32K-Keyboard N	$1,295

C—calculator keyboard (only version with tape deck)
B—large keyboard (graphics not on keys)
N—large keyboard with graphics symbols

PET ACCESSORIES

Commodore Dual Floppy Disk Drive	$1,100
Computhink 800K Disk Drive	$1,295
Commodore Printer (tractor feed)	$849
Commodore Printer (friction feed)	$995.00
Second Cassette-from Commodore	$95.00
Commodore PET Service Kit	$30.00
Beeper-Tells when tape is loaded	$24.95
Petunia-Play music from PET	$29.95
Video Buffer-Attach another CRT	$29.95
Combo-Petunia and Video Buffer	$49.95
New Serial Printer Interface for PET	$79.95
KIM 1 (A Single Board Computer from Commodore)	$179.00

Hazeltine 1400

Immediate Delivery—
2-Year Factory Warranty

LIST	SALE
~~$950~~	$649

Hazeltine 1410 — $835 **Hazeltine 1510 — $1195**
Hazeltine 1500 — $1069 **Hazeltine 1520 — $1499**

Lear Siegler's ADM-3A

Back Again at Our Lowest Price Ever

The ADM-3A is industry's favorite dumb terminal for some very smart reasons:

- 12 in. diagonal screen
- Full or half duplex operation at 11 selectable data rates
- 1920 easy-to-read characters in 24 rows of 80 letters
- Typewriter-style keyboard
- RS-232 C interface extension port
- Direct cursor addressing

Our Low Sale Price $795

SAVE $195 SPECIAL

COMMODORE DISK DRIVES

Reg. $1,295 Sale $1,100

apple II plus

$200 FREE ACCESSORIES

The new Apple II with Applesoft BASIC built-in! Eliminates the need for a $200 Firmware Card and includes new Autostart ROM for easy operation. This combined with the FREE accessories from NCE could save you up to $400 on a 48K Apple II system!

16K Apple II Plus—$1195 (take $100 in free accessories)
32K Apple II Plus—$1345 (take $150 in free accessories)
48K Apple II Plus—$1495 (take $200 in free accessories)

Apple II Accessories

General Business	$625
PASCAL	$495
Integer BASIC ROM Card	$200
VISI-Calc	$99
Centronics Printer Interface	$225
Disk and Controller	$595
Parallel Printer Card	$180
Communications Card	$225
Hi-Speed Serial Card	$195
Firmware Card	$200

PET OWNERS . . .

REMOTE TERMINAL for only $69

A self-contained module and program cassette enables your PET to function as a 300 baud terminal. Supports Upper/Lower case, Rubout, Escape & all control functions. Output is TTL.

FREE WITH PET PURCHASE

CAT COUPLER

New 300 baud Originate/Answer Acoustic Coupler. Looks good, works great.

priced at **$189**

NEW!

ZENITH COLOR VIDEO MONITOR

Zenith's first color video display designed specifically for computers.

This 13-inch monitor is Zenith's first color video display designed specifically for computers. Features include automatic color level, color processing and degaussing circuits.

Zenith Color Monitor $499.00

NEW from Heath Data Systems

The All-In-One Computer

Dual Z-80 Processors • Built-in 102K Floppy Disk • 16K to 48K RAM • 25 x 80 Character Display • Upper/Lower Case and Line Graphics • 80 Character Keyboard with Keypad • 8 User-definable Keys • Two BASIC's and Auto-Scribe Word Processing available • Can support CP/M

Heath's third generation of computers is a compact, hi-style desktop unit which includes a complete terminal, a computer and a disk All-In-One! System includes Bootstrap in ROM, other programs available separately. HDOS operating system includes Heath's BASIC, an assembler and text editor along with important disk utilities. Microsoft language requires HDOS.

WH89 with 16K RAM	$2,295
WH89 with 32K RAM	$2,445
WH89 with 48K RAM	$2,595
WH17 Second Disk Drive	$550
Dual-port Serial Interface	$85
HDOS Operating System	$100
Microsoft BASIC	$100
Word Processing	$395

FREE

Just Released

Compumart's New Fall/Winter 1979 Catalog.

We've just published our catalog and its packed with new products and money saving specials. Our illustrated 32-page book features microcomputers and microcomputer systems from Apple, Commodore PET, Heath, and Exidy Sorcerer. Also covered are the Commodore's KIM and Rockwell's AIM. A broad selection of terminals, books, software and peripherals are presented in detail. The text is thorough and provides a wealth of technical information. To get your FREE copy write to our address below. Please include the dept. number to speed handling.

IN STOCK NOW!

EVERY ITEM IN THIS ADVERTISEMENT IS IN STOCK AND READY TO SHIP, EXCEPT WHERE NOTED.

PAPER TIGER 440SPE

The Graphics Printer for Apple II

Now you can print illustrations, block letters, charts, graphs, and more—all under software control. And with the expanded buffer, the Paper Tiger can hold the text from an entire 24-line-by-80-column CRT screen.

$1194.00

CENTRONIC'S 779-2 PRINTER

TRACTOR FEED

- Parallel interface
- Continuous variable printing density 80-132 characters per line
- 5x7 dot matrix

SALE PRICE $1095

- Form thickness control
- Horizontal and vertical form positioning
- Used with controller (Apple general business software)

SANYO MONITOR

$169 **$279**

9-inch ~~$240~~ 15-inch ~~$490~~

CompuMart SINCE 1971

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IMPORTANT ORDERING INFORMATION
All orders must include 4% shipping and handling. Mass. residents add 5% sales tax; Mich. residents 4%, for sales tax.

Phones open from 8:30 a.m. to 5:30 p.m. EST Mon.-Fri. • P.O.'s accepted from D&B rated companies — shipment contingent upon receipt of signed purchase order • Sorry no C.O.D.s • All prices are subject to change without notice • Most items in stock for immediate shipment — call for delivery quotation • In the Ann Arbor area? Our retail store is open 11:00 a.m. to 7:00 p.m. Tues.-Fri., 10:00 a.m. to 5:00 pm. Saturdays (closed Sun. and Mon.)

If not satisfied, return your purchase with-in 10 days for full refund of purchase price!

Continuity Tester and Flashlight

Convenient versatile tool for quickly checking continuity of dead circuits, switches, appliances, cords, fuses, motors, control equipment, coils and panel boards. Also tests circuits for low-resistance shorts and helps identify wires in multi-wire cables. Dozens of other uses. Plus the added convenience of a handy, durable flashlight. Uses two AA size penlight batteries (not furnished). Insulated clip prevents accidental shorting to case. Alligator clip has 48" lead with plug.

RT300 ..... **$7.95**

Custom Cables & Jumpers

DB 25 Series Cables

Part No.	Cable Length	Connectors	Price
DB25P-4-P	4 Ft.	2-DP25P	$15.95 ea.
DB25P-4-S	4 Ft.	1-DP25P/1-25S	$16.95 ea.
DB25S-4-S	4 ft.	2-DP25S	$17.95 ea.

Dip Jumpers

DJ14-1	1 ft.	1-14 Pin	$1.59 ea.
DJ16-1	1 ft.	1-16 Pin	1.79 ea.
DJ24-1	1 ft.	1-24 Pin	2.79 ea.
DJ14-1-14	1 ft.	2-14 Pin	2.79 ea.
DJ16-1-16	1 ft.	2-16 Pin	3.19 ea.
DJ24-1-24	1 ft.	2-24 Pin	4.95 ea.

For Custom Cables & Jumpers, See JAMECO 1980 Catalog for Pricing

25 PIN-D SUBMINIATURE CONNECTORS

(Meets RS232)

PART NO.	DESCRIPTION	PRICE
DB25P	PLUG (as pictured)	$2.95
DB25S	SOCKET	3.50
DB51226-1	CABLE COVER for DB25P or DB25S...	1.75
DB25P-831	PLUG – Right Angle – P.C. Mount	4.95
DB25S-831	SOCKET – Right Angle – P.C. Mount ..	5.25

Printed Circuit Connectors

.156 Spacing-Tin-Double Read-Out
Bifurcated Contacts
Fits .054 to .070 P.C. Boards

PART NO.	DESCRIPTION	PRICE
15/30 SE	15/30 Contacts – solder eyelet	$1.95
18/36 SE	18/36 Contacts – solder eyelet	2.49
22/44 SE	22/44 Contacts – solder eyelet	2.95
22/44 WW	22/44 Contacts – wire wrap	3.95
50/100 WW	50/100 Contacts – wire wrap (R681-1). (.125 Spacing)	6.95

Jumbo 6-Digit Clock Kit

- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾ x 3⅛ x 1¾

JE747 ..... **$29.95**

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

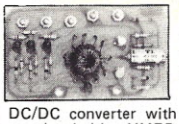
JE701

6-Digit Clock Kit $19.95

Regulated Power Supply

Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½" x 5" x 2"H

JE200 ..... **$14.95**



ADAPTER BOARD
—Adapts to JE200—
±5V, ±9V and ±12V

DC/DC converter with +5V input. Toriodal hi-speed switching XMFR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½" x 2" x 9/16"H

JE205 ..... **$12.95**

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

8080A	CPU	$ 7.95
8212	8-Bit Input/Output	3.25
8214	Priority Interrupt Control	5.95
8216	Bi-Directional Bus Driver	3.49
8224	Clock Generator/Driver	3.95
8226	Bus Driver	3.49
8228	System Controller/Bus Driver	4.95
8238	System Controller	5.95
8251	Prog. Comm. 1/0 (USART)	7.95
8253	Prog. Interval Timer	14.95
8255	Prog. Periph. 1/0 (PPI)	9.95
8257	Prog. DMA Control	19.95
8259	Prog. Interrupt Control	19.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	$14.95
MC6802CP	MPU with Clock and Ram	24.95
MC6810API	128X8 Static Ram	5.95
MC6821	Periph. Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	7.95
MC6852	Synchronous Serial Data Adapt.	9.95
MC6860	0-600 bps Digital MODEM	12.95
MC6862	2400 bps Modulator	14.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS—MISCELLANEOUS

Z80(780C)	CPU	$14.95
Z80A(780-1)	CPU	16.95
CDP1802	CPU	19.95
2650	MPU	19.95
6502	CPU	11.95
8035	8-Bit MPU w/clock, RAM, 1/0 lines	19.95
P8085	CPU	19.95
TMS9900JL	16-Bit MPU w/hardware, multiply & divide	49.95

SHIFT REGISTERS

MM500H	Dual 25 Bit Dynamic	$.50
MM503H	Dual 50 Bit Dynamic	.50
MM504H	Dual 16 Bit Static	.50
MM506H	Dual 100 Bit Static	.50
MM510H	Dual 64 Bit Accumulator	.50
MM5016H	500/512 Bit Dynamic	.89
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2522	Dual 132 Bit Static	2.95
2524	512 Static	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
3341	Fifo	6.95
74LS670	4X4 Register File (TriState)	2.49

UART'S

A-Y-5-1013	30K BAUD	5.95

MICROPROCESSOR MANUALS

M-Z80	User Manual	$7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

ROM'S

2513(2140)	Character Generator(upper case)	$9.95
2513(3021)	Character Generator(lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

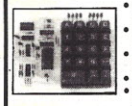
RAM'S

1101	256X1	Static	$1.49
1103	1024X1	Dynamic	.99
2101(8101)	256X4	Static	3.95
2102	1024X1	Static	1.75
21L02	1024X1	Static	1.95
2111(8111)	256X4	Static	3.95
2112	256X4	Static MOS	4.95
2114	1024X4	Static 450ns	7.95
2114L	1024X4	Static 450ns low power	10.95
2114-3	1024X4	Static 300ns	10.95
2114L-3	1024X4	Static 300ns low power	11.95
5101	256X4	Static	7.95
5280/2107	4096X1	Dynamic	4.95
7489	16X4	Static	1.75
74S200	256X1	Static Tristate	4.95
93421	256X1	Static	2.95
UPD414 (MK4027)	4K	Dynamic 16 pin	4.95
UPD416 (MK4116)	16K	Dynamic 16 pin 250ns	9.95
TMS4044-45NL	4K	Static	14.95
TMS4045	1024X4	Static	14.95
2117	16,384X1	Dynamic 350ns (house marked)	9.95
MM5262	2KX1	Dynamic	4/1.00

PROM'S

1702A	2048	FAMOS	$5.95
2716INTEL	16K*	EPROM	59.95
TMS2516	16K*	EPROM	49.95
(2716)	*Requires single +5V power supply		
TMS2532	4KX8	EPROM	89.95
2708	8K	EPROM	10.95
2716 T.I	16K**	EPROM	29.95
	**Requires 3 voltages, —5V, +5V, +12V		
5203	2048	FAMOS	14.95
6301-1(7611)	1024	Tristate Bipolar	3.49
6330-1(7602)	256	Open C Bipolar	2.95
82S23	32X8	Open Collector	3.95
82S115	4096	Bipolar	19.95
82S123	32X8	Tristate	3.95
74186	512	TTL Open Collector	9.95
74188	256	TTL Open Collector	3.95
74S287	1024	Static	2.95

JE600 HEXADECIMAL ENCODER KIT



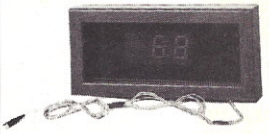
FEATURES:
- Full 8 bit latched output for microprocessor use
- 3 User Define keys with one being bistable operation
- Debounce circuit provided for all 19 keys
- LED readout to verify entries
- Easy interfacing with standard 16 pin IC connector
- Only +5VDC required for operations

FULL 8 BIT LATCHED OUTPUT—19 KEYBOARD

The JE600 Encoder Keyboard provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8 bit microprocessor or 8 bit memory circuits. Three (3) additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with LED readouts. Also included is a key entry strobe.

JE600 ..... **$59.95**
Hexadecimal Keypad only **$14.95**

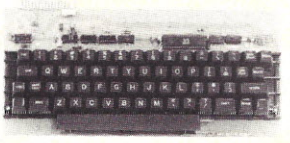
DIGITAL THERMOMETER KIT



- Dual sensors—switching control for indoor/outdoor or dual monitoring
- Continuous LED .8" ht. display
- Range: -40°F to 199°F / -40°C to 100°C
- Accuracy: ±1° nominal
- Set for Fahrenheit or Celsius reading
- Slim, walnut case - AC wall adapter incl.
- Size: 3-1/4"H x 6-5/8"W x 1-3/8"D

JE300 ..... **$39.95**

62-Key ASCII Encoder Keyboard Kit



The JE610 62-Key ASCII Encoder Keyboard Kit can be interfaced into most any computer system. The JE610 Kit comes complete with an industrial grade keyboard switch assembly (62 keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and —12V @ 10mA for operation.

FEATURES:
- 60 Keys generate the full 128 characters, upper and lower case ASCII set
- Fully buffered
- 2 user-define keys provided for custom applications
- Caps lock for upper case only alpha characters
- Utilizes a 2376 (40 pin) encoder read only memory chip
- Outputs directly compatible with TTL/DTL or MOS logic arrays
- Easy interfacing with a 16-pin dip or 18-pin edge connector

JE610 ..... **$79.95**
62-Key Keyboard only . . $34.95

HICKOK LX303 Portable LCD Digital Multimeter

- Big ½ inch high, 3½ Digit Liquid Crystal Display
- Over 200 Hours of operation with a 9V battery
- Automatic zero, polarity and overrange indication
- 100mV DC F.S. sensitivity
- 1% basic accuracy
- 19 ranges and functions
- Rugged Cycolac® case and removable cover, stores test lead set.
- Full one year warranty.

SPECIFICATIONS: DC volts (5 ranges): 0.1mV to 1000V; Accuracy ±0.5% rdg ±0.5% f.s., Input imped: 10MΩ, Max. input 1kV except 500V on 200mV range.
AC Volts (40Hz to 5kHz): 0.1V to 600V; Accuracy ±1.0% rdg ±0.5% f.s. (—2dB max. at 5kHz); Max. input: 600V.
Resistance (6 Low Power Ranges): 0.1 to 20MΩ; Accuracy ±0.5% rdg ±0.5% f.s. (±1.5% rdg on 20MΩ range); input protected to 120VAC all ranges.
DC Current (6 ranges): 01mA to 100mA, Accuracy ±1.0% rdg ±0.5% f.s.
Dimensions and Weight: 5-7/8" x 3-3/8" x 1-3/4", 8 oz.; POWER: 9V battery (not included) or Hickok AC adapter; READ RATE: 3/sec

LX303 Digital Multimeter **$74.95**

PART NO.	DESCRIPTION	PRICE
RC-3	115V AC ADAPTER	7.50
CC-3	PADDED CARRYING CASE	7.50
VP-10	X10 DC PROBE ADAPTER (Up to 10K)	14.95
VP-40	40k-V DC PROBE	35.00
CS-1	10 Amp DC Current Shunt	14.95

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The Incredible "Pennywhistle 103"

$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modern and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method .....Frequency-Shift Keying, full-duplex (half-duplex selectable).
Maximum Data Rate .....300 Baud.
Data Format .....Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies ...2025 Hz for space; 2225 Hz for mark.
Transmit Channel Frequencies ..Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 025 space, 2225 mark.
Receive Sensitivity .....–46 dbm accoustically coupled.
Transmit Level .....–15 dbm nominal. Adjustable from –6 dbm to –20 dbm.
Receive Frequency Tolerance ...Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface .....EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements .....120 VAC, single phase, 10 Watts.
Physical .....All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
- ★ 8 each UPD416-1 (16K Dynamic Rams) 250NS
- ★ Documentation for conversion

TRS-16K **$75.00**

JUST WRAP™

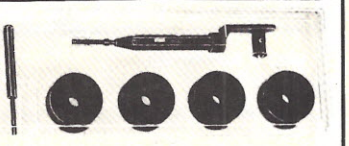
- 30 AWG wire
- Daisy chain or point-to-point
- No stripping or slitting required—just wrap
- .025" square posts
- Built-in cut off
- Includes 50 ft. wire

Part No.	Wire Color	Price
JW-1-B	Blue	$14.95
JW-1-W	White	14.95
JW-1-Y	Yellow	14.95
JW-1-R	Red	14.95

JUST WRAP™ Replacement Wire

Part No.	Color	Price
R-JW-B	Blue ..... 50 ft. roll	$2.98
R-JW-W	White ..... 50 ft. roll	2.98
R-JW-Y	Yellow ..... 50 ft. roll	2.98
R-JW-R	Red ..... 50 ft. roll	2.98

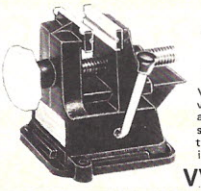
JUST WRAP™ Unwrap Tool $3.49



JUST WRAP™ Kit

- 50 ft. ea.: blue, white, red, yellow wire
- JUST WRAP Tool
- Unwrapping Tool

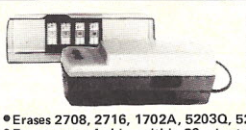
JWK-6 ..... **$24.95**



Vacuum Vise

Vacuum-based light-duty vise for small components and assemblies. ABS construction. 1½" jaws, 1¼" travel. Can be permanently installed.

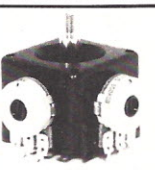
VV-1 ..... **$3.49**



EPROM Erasing Lamp

- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch
- Special conductive foam liner eliminates static build-up
- Built-in safety lock to prevent UV exposure
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips

UVS-11E **$69.95**



Micro-Miniature Joystick

- 2 each 100K pots (Linear Taper)
- Printed Circuit Board Mount
- Size: 1" x 1-3/16" x 1-3/16"

Micro-Miniature Joystick ... $4.95

7400 TTL

		SN7470N	.29		
		SN7472N	.29		
SN7400N	.16	SN7473N	.35	SN74160N	.89
SN7401N	.18	SN7474N	.35	SN74161N	.89
SN7402N	.18	SN7475N	.49	SN74162N	1.95
SN7403N	.18	SN7476N	.35	SN74163N	.89
SN7404N	.18	SN7479N	5.00	SN74164N	.89
SN7405N	.20	SN7480N	.50	SN74165N	.89
SN7406N	.29	SN7482N	.99	SN74166N	1.25
SN7407N	.29	SN7483N	.59	SN74167N	1.95
SN7408N	.20	SN7485N	.79	SN74170N	1.59
SN7409N	.20	SN7486N	.35	SN74172N	6.00
SN7410N	.18	SN7489N	1.75	SN74173N	1.25
SN7411N	.25	SN7490N	.45	SN74174N	.89
SN7412N	.25	SN7491N	.59	SN74175N	.79
SN7413N	.40	SN7492N	.43	SN74176N	.79
SN7414N	.70	SN7493N	.43	SN74177N	.79
SN7416N	.25	SN7494N	.65	SN74179N	1.95
SN7417N	.25	SN7495N	.65	SN74180N	.79
SN7420N	.20	SN7496N	.65	SN74181N	1.95
SN7421N	.29	SN7497N	3.00	SN74182N	.79
SN7422N	.39	SN74100N	.89	SN74184N	1.95
SN7423N	.25	SN74107N	.35	SN74185N	1.95
SN7425N	.29	SN74109N	.59	SN74186N	9.95
SN7426N	.29	SN74116N	1.95	SN74188N	3.95
SN7427N	.25	SN74121N	.35	SN74190N	1.25
SN7429N	.39	SN74122N	.39	SN74191N	1.25
SN7430N	.20	SN74123N	.49	SN74192N	.79
SN7432N	.25	SN74125N	.49	SN74193N	.79
SN7437N	.25	SN74126N	.49	SN74194N	.89
SN7438N	.25	SN74132N	.75	SN74195N	.69
SN7439N	.25	SN74136N	.75	SN74196N	.89
SN7440N	.20	SN74141N	.79	SN74197N	.89
SN7441N	.89	SN74142N	2.95	SN74198N	1.49
SN7442N	.49	SN74143N	2.95	SN74199N	1.49
SN7443N	.75	SN74144N	2.95	SN74S200	4.95
SN7444N	.75	SN74145N	.79	SN74251N	.99
SN7445N	.75	SN74147N	1.95	SN74279N	.79
SN7446N	.69	SN74148N	1.29	SN74283N	2.25
SN7447N	.59	SN74150N	.89	SN74284N	3.95
SN7448N	.79	SN74151N	.59	SN74285N	3.95
SN7450N	.20	SN74152N	.59	SN74365N	.69
SN7451N	.20	SN74153N	.59	SN74366N	.69
SN7453N	.20	SN74154N	.99	SN74367N	.69
SN7454N	.20	SN74155N	.79	SN74368N	.69
SN7459A	.25	SN74156N	.79	SN74390N	1.95
SN7460N	.20	SN74157N	.65	SN74393N	1.95

C/MOS

CD4000	.23			CD4070	.55
CD4001	.23			CD4071	.23
CD4002	.23	CD4028	.89	CD4072	.49
CD4006	1.19	CD4029	1.19	CD4076	1.39
CD4007	.25	CD4030	.49	CD4081	.23
CD4009	.49	CD4035	.99	CD4082	.23
CD4010	.49	CD4040	1.19	CD4093	.99
CD4011	.23	CD4041	1.25	CD4098	2.49
CD4012	.25	CD4042	.99	MC14409	14.95
CD4013	.39	CD4043	.89	MC14410	14.95
CD4014	1.39	CD4044	.89	MC14411	14.95
CD4015	1.19	CD4046	1.79	MC14419	4.95
CD4016	.49	CD4047	2.50	MC14433	19.95
CD4017	1.19	CD4048	1.35	MC14506	.75
CD4018	.99	CD4049	.49	MC14507	.99
CD4019	.49	CD4050	.49	MC14562	14.50
CD4020	1.19	CD4051	1.19	MC14583	3.50
CD4021	1.39	CD4053	1.19	CD4508	3.95
CD4022	1.19	CD4056	2.95	CD4510	1.39
CD4023	.23	CD4059	9.95	CD4511	1.29
CD4024	.79	CD4060	1.49	CD4515	2.95
CD4025	.23	CD4066	.79	CD4518	1.29
CD4026	2.25	CD4068	.39	CD4520	1.29
CD4027	.69	CD4069	.45	CD4566	2.25

74C00

74C00	.39			74C163	2.49
74C02	.39			74C164	2.49
74C04	.39	74C85	2.49	74C173	2.60
74C08	.49	74C90	1.95	74C192	2.49
74C10	.39	74C93	1.95	74C193	2.49
74C14	1.95	74C95	1.95	74C195	2.49
74C20	.39	74C107	1.25	74C922	7.95
74C30	.39	74C151	2.90	74C923	6.25
74C42	1.95	74C154	3.00	74C925	8.95
74C48	2.49	74C157	2.15	74C926	8.95
74C73	.89	74C160	2.49	80C95	1.50
74C74	.89	74C161	2.49	80C97	1.50

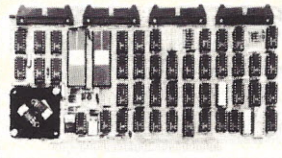
LINEAR

78MG	1.75			LM710N	.79
LM106H	.99			LM711N	.39
LM300H	.80	LM340K-18	1.35	LM723N/H	.55
LM301CN/H	.35	LM340K-24	1.35	LM733N	1.00
LM302H	.75	LM340T-5	1.25	LM739N	1.19
LM304H	1.00	LM340T-6	1.25	LM741CN/H	.35
LM305H	.60	LM340T-8	1.25	LM741-14N	.39
LM307CN/H	.35	LM340T-12	1.25	LM747N/H	.79
LM308CN/H	1.00	LM340T-15	1.25	LM748N/H	.39
LM309H	1.10	LM340T-18	1.25	LM1310N	1.95
LM309K	1.25	LM340T-24	1.25	LM1458CN/H	.59
LM310CN	1.15	LM358N	1.00	MC1488N	1.95
LM311N/H	.90	LM370N	1.95	MC1489N	1.95
LM312H	1.95	LM373N	3.25	LM1496N	.95
LM317K	6.50	LM377N	4.00	LM1556V	1.75
LM318CN/H	1.50	LM380N	1.25	MC1741SCP	3.00
LM319N	1.30	LM380CN	.99	LM2111N	1.95
LM320K-5	1.35	LM381N	1.79	LM2901N	2.95
LM320K-5.2	1.35	LM382N	1.79	LM3053N	1.50
LM320K-12	1.35	NE501N	8.00	LM3065N	1.49
LM320K-15	1.35	NE510A	6.00	LM3900N(3401)	.59
LM320K-18	1.35	NE529A	4.95	LM3905N	1.49
LM320K-24	1.35	NE531H/V	3.95	LM3909N	1.25
LM320T-5	1.25	NE536T	6.00	MC5558V	.59
LM320T-5.2	1.25	NE540L	6.00	8038B	4.95
LM320T-8	1.25	NE544N	4.95	LM75450N	.49
LM320T-12	1.25	NE550N	1.30	75451CN	.39
LM320T-15	1.25	NE555V	.39	75452CN	.39
LM320T-18	1.25	NE556N	.99	75453CN	.39
LM320T-24	1.25	NE560B	5.00	75454CN	.39
LM323K-5	5.95	NE561B	5.00	75491CN	.79
LM324N	1.49	NE562B	5.00	75492CN	.89
LM339N	.99	NE565N/H	1.25	75493N	.89
LM340K-5	1.35	NE566CN	1.75	75494CN	.89
LM340K-6	1.35	NE567V/H	.99	RC4136	1.25
LM340K-8	1.35	NE570N	4.95	RC4151	3.95
LM340K-12	1.35	LM703CN/H	.69	RC4194	4.95
LM340K-15	1.35	LM709N/H	.29	RC4195	4.49

74LS00TTL

74LS00	.29			74LS138	.89
74LS01	.29	74LS47	.89	74LS139	.89
74LS02	.29	74LS51	.29	74LS151	.89
74LS03	.29	74LS54	.29	74LS155	.89
74LS04	.35	74LS55	.29	74LS157	.89
74LS05	.35	74LS73	.45	74LS160	1.15
74LS08	.29	74LS74	.45	74LS161	1.15
74LS09	.35	74LS75	.59	74LS162	1.25
74LS10	.29	74LS76	.45	74LS163	1.15
74LS11	.75	74LS78	.49	74LS164	1.25
74LS13	.59	74LS83	.89	74LS175	.99
74LS14	1.25	74LS85	1.25	74LS181	2.49
74LS15	.35	74LS86	.45	74LS190	1.15
74LS20	.29	74LS90	.59	74LS191	1.15
74LS21	.35	74LS92	.75	74LS192	1.15
74LS22	.35	74LS93	.75	74LS193	1.15
74LS26	.35	74LS95	.99	74LS194	1.15
74LS27	.35	74LS96	1.15	74LS195	1.15
74LS28	.35	74LS107	.45	74LS253	.99
74LS30	.29	74LS109	.45	74LS257	.89
74LS32	.35	74LS112	.45	74LS258	1.75
74LS37	.45	74LS123	1.25	74LS260	.69
74LS40	.35	74LS125	.89	74LS279	.75
74LS42	.89	74LS132	.99	74LS367	.75
		74LS136	.49	74LS368	.75
				74LS670	2.49

Cromemco
incorporated



TU-ART Digital Interface

Cromemco's TU-ART digital interface is a convenient interface for CRT terminals, line printers, modems, and other devices. Has 2 serial I/O ports, 2 8-bit parallel I/O ports, and 10 independent programmable interval timers. Baud rates are software-selectable from 110-76,800 baud. Has vectored prioritized interrupts so it is able to support the powerful vectored interrupt structure of a Z-80 microprocessor. 10 interval timers w/real-time capability.

Serial I/O Ports:
No. of ports: 2
I/O levels: RS-232 or 20mA curr. loop
Low baud range: 110-9600 baud (software selectable)
High baud range: 880-76,800 baud (software selectable)
Parallel I/O Ports:
No. of ports: 2 Input ports: 8 bits
Output ports: 8 bits
Input load: one TTL equivalent
Output Drive: 20 TTL loads

Interval Timers:
No. of timers: 10
Timer range: 0-16.32 msec (software selectable)
Timer resolution: 64 microseconds
Vectored Interrupts:
No. restart locations (8080 mode): 8
No. restart locs. (Z-80 mode): 65,536
Prioritization of TU-ART ports: internally prioritized
Prioritization for multiple TU-ARTs: daisy-chaining

General Information:
UART Type: 5501 Bus: S-100
Power requirements: +8V @ 1.0A
+18V @ 80mA −18V @ 40mA
Operating environment: 0-55°C

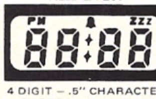
TRT-W (Assembled) $295.00

DISCRETE LEDS

.200" dia.			.125" dia.		
XC556R	red	5/$1	XC209R	red	5/$1
XC556G	green	4/$1	XC209G	green	4/$1
XC556Y	yellow	4/$1	XC209Y	yellow	4/$1
XC556C	clear	4/$1			
.200" dia.			.185" dia.		
XC22R	red	5/$1	XC526R	red	5/$1
XC22G	green	4/$1	XC526G	green	4/$1
XC22Y	yellow	4/$1	XC526Y	yellow	4/$1
.170" dia.			XC526C	clear	4/$1
MV10B	red	4/$1	.190" dia.		
.085" dia.			XC111R	red	5/$1
MV50	red	6/$1	XC111G	green	4/$1
			XC111Y	yellow	4/$1
			XC111C	clear	4/$1

INFRA-RED LED
1/4"x1/4"x1/16" flat
5/$1

TIMEX T1001
LIQUID CRYSTAL DISPLAY CLASS II
FIELD EFFECT



4 DIGIT – .5" CHARACTERS
THREE ENUNCIATORS
2.00" X 1.20" PACKAGE
INCLUDES CONNECTOR

T1001-Transmissive	$7.95
T1001A-Reflective	8.25

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ± 1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red-D.D.	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	.99
MAN 72	Common Anode-red	.300	.75	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.49	DL728	Common Cathode-red	.500	1.49
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3620	Common Anode-orange	.300	.49	DL746	Common Anode-red ± 1	.630	1.49
MAN 3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL33B	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	5082-7730	Common Anode-red	.300	.99
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	1.50
MAN 6640	Common Cathode-orange-D.D.	.560	.99	HDSP-3403	Common Cathode red	.800	1.50
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl. Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character,(±1)	.600	15.00
MAN 6710	Common Anode-red-D.D.	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013T	2.15	CA3082N	2.00
CA2023T	2.56	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	.85	CA3401N	.59
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7 seg. C.A. LED driver	1.50

CLOCK CHIPS

MM5309	$4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998A	4.95
CT7001	6.95

MOTOROLA

MC1408L7	$4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin LP	.$17	.16	.15	22 pin LP	$ .37	.36	.35
14 pin LP	.20	.19	.18	24 pin LP	.38	.37	.36
16 pin LP	.22	.21	.20	28 pin LP	.45	.44	.43
18 pin LP	.29	.28	.27	36 pin LP	.60	.59	.58
20 pin LP	.34	.32	.30	40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100		1-24	25-49	50-100
14 pin ST	$.27	.25	.24	28 pin ST	$ .99	.90	.81
16 pin ST	.30	.27	.25	36 pin ST	1.39	1.26	1.15
18 pin ST	.35	.32	.30	40 pin ST	1.59	1.45	1.30
24 pin ST	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin SG	$.30	.27	.24	24 pin SG	$ .70	.63	.57
14 pin SG	.35	.32	.29	28 pin SG	1.10	1.00	.90
16 pin SG	.38	.35	.32	36 pin SG	1.65	1.40	1.26
18 pin SG	.52	.47	.43	40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin WW	$.39	.38	.31	22 pin WW	$ .95	.85	.75
10 pin WW	.45	.41	.37	24 pin WW	1.05	.95	.85
14 pin WW	.39	.38	.37	28 pin WW	1.40	1.25	1.10
16 pin WW	.43	.42	.41	36 pin WW	1.59	1.45	1.30
18 pin WW	.75	.68	.62	40 pin WW	1.75	1.55	1.40
20 pin WW	.85	.79	.72				

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea.	10 OHM / 27 OHM	12 OHM / 33 OHM	15 OHM / 39 OHM	18 OHM / 47 OHM	22 OHM / 56 OHM	50 PCS	$1.75
ASST. 2	5 ea.	68 OHM / 180 OHM	82 OHM / 220 OHM	100 OHM / 270 OHM	120 OHM / 330 OHM	150 OHM / 390 OHM	50 PCS	1.75
ASST. 3	5 ea.	470 OHM / 1.2K	560 OHM / 1.5K	680 OHM / 1.8K	820 OHM / 2.2K	1K / 2.7K	50 PCS	1.75
ASST. 4	5 ea.	3.3K / 8.2K	3.9K / 10K	4.7K / 12K	5.6K / 15K	6.8K / 18K	50 PCS	1.75
ASST. 5	5 ea.	22K / 56K	27K / 68K	33K / 82K	39K / 100K	47K / 120K	50 PCS	1.75
ASST. 6	5 ea.	150K / 390K	180K / 470K	220K / 560K	270K / 680K	330K / 820K	50 PCS	1.75
ASST. 7	5 ea.	1M / 2.7M	1.2M / 3.3M	1.5M / 3.9M	1.8M / 4.7M	2.2M / 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

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AY-5-9100	Push Button Telephone Dialler	$14.95
AY-5-9200	Repertory Dialler	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	14.95
HD0165	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	7.95
74C923	Keyboard Encoder (20 keys)	6.25

ICM CHIPS

ICM7045	CMOS Precision Timer	24.95
ICM7205	CMOS LED Stopwatch/Timer	19.95
ICM7207	Oscillator Controller	7.50
ICM7208	Seven Decade Counter	19.95
ICM7209	Clock Generator	6.95

NMOS READ ONLY MEMORIES

MCM6571	128 X 9 X 7 ASCII Shifted with Greek	13.50
MCM6574	128 X 9 X 7 Math Symbol & Pictures	13.50
MCM6575	128 X 9 X 7 Alpha Control Char. Gen	13.50

MISCELLANEOUS

TL074CN	Quad Low Noise bi-fet Op Amp	2.49
TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
95H90	Hi-Speed Divide 10/11 Prescaler	11.95
4N33	Photo-Darlington Opto-Isolator	3.95
MK50240	Top Octave Freq. Generator	17.50
DS0026CH	5Mhz 2-phase MOS clock driver	3.75
TIL308	.27" red num. display w/integ. logic chip	10.95
MM5320	TV Camera Sync. Generator	14.95
MM5330	4½ Digit DPM Logic Block (Special)	3.95
LD110/111	3½ Digit A/D Converter Set	25.00/set
MC14433P	3½ Digit A/D Converter	13.95

LITRONIX ISO-LIT 1
Photo Transistor Opto-Isolator
(Same as MCT 2 or 4N25)
49¢ each

SN 76477
SOUND GENERATOR
Generates Complex Sounds
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$3.95 each

TV GAME CHIP AND CRYSTAL
AY-3-8500-1 and 2.01 MHZ Crystal (Chip & Crystal includes score display, 6 games and select angles, etc. **7.95/set**

EXAR

XR205	$8.40			XR2242CP	1.50
XR210	4.40			XR2264	4.25
XR215	4.40			XR2556	3.20
XR320	1.55			XR2567	2.99
XR-L555	1.50	JE2206KB	19.95	XR3403	1.25
XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	3.95
XR567CP	.99	XR2207	3.85	XR4194	4.95
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.95	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.95	XR2212	4.35	XR4739	1.15
XR1489	1.95	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
				1N4002	100 PIV	1 AMP	12/1.00
				1N4003	200 PIV	1 AMP	12/1.00
1N746	3.3	400m	4/1.00	1N4004	400 PIV	1 AMP	12/1.00
1N751	5.1	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N754	6.8	400m	4/1.00	1N3600	50	200m	6/1.00
1N757	9.0	400m	4/1.00	1N4148	75	10m	15/1.00
1N759	12.0	400m	4/1.00	1N4154	35	10m	12/1.00
1N959	8.2	400m	4/1.00	1N4733	5.1	1w	28
1N965	15	400m	4/1.00	1N4734	5.6	1w	28
1N5232	5.6	500m	28	1N4735	6.2	1w	28
1N5234	6.2	500m	28	1N4736	6.8	1w	28
1N5235	6.8	500m	28	1N4738	8.2	1w	28
1N5236	7.5	500m	28	1N4742	12	1w	28
1N5242	12	500m	28	1N4744	15	1w	28
1N5245	15	500m	28	1N1183	50 PIV	35 AMP	1.60
1N456	25	40m	6/1.00	1N1184	100 PIV	35 AMP	1.70
1N458	150	7m	6/1.00	1N1185	150 PIV	35 AMP	1.70
1N485A	180	10m	5/1.00	1N1186	200 PIV	35 AMP	1.80
1N4001	50 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C36M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
40409	1.75	PN3567	3/1.00	PN4249	4/1.00
40410	1.75	PN3568	4/1.00	PN4250	4/1.00
40673	1.75	PN3569	4/1.00	2N4400	4/1.00
2N918	4/1.00	MPS3638A	5/1.00	2N4401	4/1.00
2N2219A	2/1.00	MPS3702	5/1.00	2N4402	4/1.00
2N2221A	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2222A	5/1.00	MPS3704	5/1.00	2N4409	5/1.00
PN2222 Plastic	7/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2369A	4/1.00	MPS3705	5/1.00	2N5087	4/1.00
MPS2369	5/1.00	2N3706	5/1.00	2N5088	4/1.00
2N2484	4/1.00	MPS3706	5/1.00	2N5089	4/1.00
2N2906	4/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2907	5/1.00	2N3711	5/1.00	PN5134	5/1.00
PN2907 Plastic	7/1.00	2N3724A	.65	PN5138	5/1.00
2N2925	5/1.00	2N3725A	1.00	2N5139	5/1.00
MJE2955	1.25	2N3772	2.25	2N5210	5/1.00
2N3053	2/1.00	2N3823	1.00	2N5449	3/1.00
		2N3903	5/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/35V	.35	.31	.27
.22/35V	.28	.23	.17	3.3/25V	.35	.31	.27
.33/35V	.28	.23	.17	4.7/25V	.33	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.49	.45	.35
.68/35V	.28	.23	.17	15/25V	.75	.68	.59
1.0/35V	.28	.23	.17	22/6V	.75	.60	.50

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead	1-9	10-99	100+	Radial Lead	1-9	10-99	100+
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

✓ Reader Service—see page 227

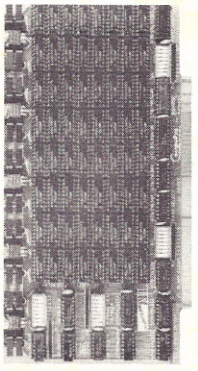
THERE'S NO NEED TO COMPROMISE WITH COMPUPRO™.

We don't compromise on our designs so you don't have to compromise on performance. Our expanded S-100 line is the answer to the needs of professional computer users – just ask the dealers who specify our components when making up systems for scientific, commercial, and industrial applications. Speaking of dealers, Godbout products (under the CompuPro™ name) are now available from more dealers than ever before . . . which makes it even easier for you to experience Godbout quality in person. Shop around, compare prices, and compare specs: we think we know whose products will earn a space in your computer.

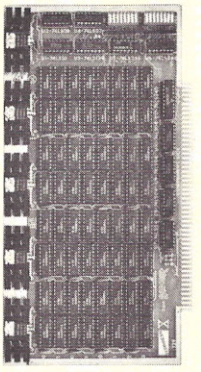
MORE NEWS FROM THE MEMORY LEADER.

This month, we spotlight **Econoram XIIIA** — an S-100 bank select board that's completely compatible with Alpha Micro, Cromemco, and similar systems (all 8 bits of the data word are available for bank select). Addressable on 4K boundaries. Available in 16K, 24K, or 32K configurations; see list below (which includes our other popular memories) for prices.

All **Econoram*** memories are fully static, run with 5 MHz (or slower) systems, include a 1 year limited warranty, and generally come in three different configurations to suit your needs — **unkit, assembled and tested,** or qualified under our high-reliability **Certified System Component** program (200 hour burn-in, immediate replacement in event of failure within 1 year of invoice date).



Name	Buss & Notes	Unkit	Assm	CSC
8K Econoram IIA	S-100	**$149**	**$179**	**$239**
16K Econoram IV	S-100	**$269**	**$329**	**$429**
16K Econoram VIIA-16	S-100	**$279**	**$339**	**$439**
24K Econoram VIIA-24	S-100	**$398**	**$485**	**$605**
16K Econoram IX-16	Dig Grp	**$319**	**$379**	n/a
32K Econoram IX-32	Dig Grp	**$559**	**$639**	n/a
32K Econoram X	S-100	**$529**	**$649**	**$789**
32K Econoram XI	SBC/BLC	n/a	n/a	**$1050**
16K Econoram XIIIA-16	S-100 (1)	**$329**	**$419**	**$519**
24K Econoram XIIIA-24	S-100 (1)	**$429**	**$539**	**$649**
32K Econoram XIIIA-32	S-100 (1)	**$559**	**$699**	**$849**
16K Econoram XIV	S-100 (2)	**$299**	**$359**	**$459**
16K Econoram XV-16	H8 (3)	**$329**	**$395**	n/a
32K Econoram XV-32	H8 (3)	**$599**	**$729**	n/a



16K × 16 or 32K × 8 Econoram XVI — coming soon!

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(2) Extended addressing (24 address lines). Single block addressable on 4K boundaries.
(3) Bank select option for implementing memory systems greater than 64K.

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The ideal home for your computer. Includes dual AC outlets and fuseholder on rear, power switch, heavy-duty line filter, black anodized front panel (with textured vinyl painted cover for desk top version); pre-drilled base accepts our high-performance S-100 motherboards or types by Vector, California Digital, and others. Rack mount version includes slides for easy pull-out from rack for maintenance or board changing. You can even cut a hole in the front panel and put in a mini-floppy . . . all in all, this is a functional, versatile, and handsome enclosure that does justice to the finest computer systems.

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PASCAL can give a microcomputer with CP/M more power than many minis! And for a limited time only, you can buy an assembled **32K Econoram X,** plus our totally standard **Wirth PASCAL/M™ 8" diskette,** for **$799** (regular combined price, $999). Includes manual, plus Wirth's definitive book on PASCAL; specify Z80 or 8080/8085 version. **Hurry — this is an introductory special.** Diskette only without memory board: $350.

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We've been expanding the memory of Model I TRS-80** machines for over a year now with our low power, high speed memory expansion chip set ($87.20). Now you can use the same chip to expand memory in Apple, newer PET, Exidy Sorcerer, and Heath H89 machines — as well as expand a 32K Model II TRS-80** to 48K or even 64K. And if that isn't enough memory for you, watch this space for news on our high-density, Model II compatible 64K board with bank select!

**TRS-80 is a trademark of the Tandy Corporation.

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Unkits have edge connectors and termination resistors pre-soldered in place for easy assembly. These boards exceed the latest S-100 specs and will work with 5 to 10 MHz CPUs. Includes true active termination, grounded Faraday shield between all buss signal lines, and edge connectors for all slots.

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4 independently addressable 4K blocks, with dipswitch selectable jump start built right into the board. Includes all support chips and manual, but does not include EROMs.

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Plugs into any S-100 motherboard (although ours don't need it) to reduce ringing, crosstalk, noise, and other buss-related problems.

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Now you can add bank select and extended addressing to older S-100 machines like the Altair, IMSAI, Sol, Polymorphic, etc. Either use this board with our new extended addressing boards, or retrofit our high density **Econorams** (the ones with phantom or extra qualifier lines) for use with the **Memory Manager** to get up to ½ a megabyte of memory space for your computer.

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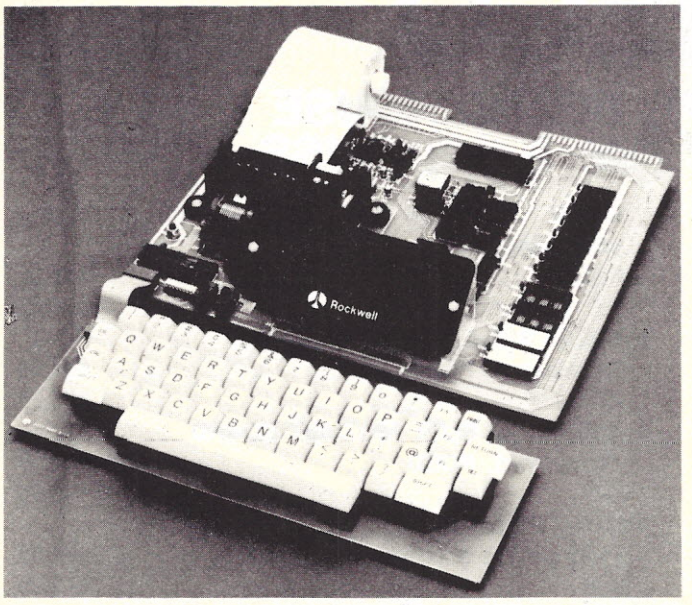
AIM 65 BY ROCKWELL INTERNATIONAL



AIM 65 is fully assembled, tested and warranted. With the addition of a low cost, readily available power supply, it's ready to start working for you.

AIM 65 features on-board thermal printer and alphanumeric display, and a terminal-style keyboard. It has an addressing capability up to 65K bytes, and comes with a user-dedicated 1K or 4K RAM. Two installed 4K ROMS hold a powerful Advanced Interface Monitor program, and three spare sockets are included to expand on-board ROM or PROM up to 20K bytes.

An Application Connector provides for attaching a TTY and one or two audio cassette recorders, and gives external access to the user-dedicated general purpose I/O lines.

Also included as standard are a comprehensive AIM 65 User's Manual, a handy pocket reference card, an R6500 Hardware Manual, an R6500 Programming Manual and an AIM 65 schematic.

AIM 65 is packaged on two compact modules. The circuit module is 12 inches wide and 10 inches long, the keyboard module is 12 inches wide and 4 inches long. They are connected by a detachable cable.

THERMAL PRINTER
Most desired feature on low-cost microcomputer systems . . .
- Wide 20-column printout
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- Fast 120 lines per minute
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- Proven reliability

FULL-SIZE ALPHANUMERIC KEYBOARD
Provides compatibility with system terminals . . .
- Standard 54 key, terminal-style layout
- 26 alphabetic characters
- 10 numeric characters
- 22 special characters
- 9 control functions
- 3 user-defined functions

TRUE ALPHANUMERIC DISPLAY
Provides legible and lengthy display . . .
- 20 characters wide
- 16-segment characters
- High contrast monolithic characters
- Complete 64-character ASCII alphanumeric format

PROVEN R6500 MICROCOMPUTER SYSTEM DEVICES
Reliable, high performance NMOS technology . . .
- R6502 Central Processing Unit (CPU), operating at 1 MHz. Has 65K address capability, 13 addressing modes and true index capability. Simple but powerful 56 instructions.
- Read/Write Memory, using R2114 Static RAM devices. Available in 1K byte and 4K byte versions.
- 8K Monitor Program Memory, using R2332 Static ROM devices. Has sockets to accept additional 2332 ROM or 2532 PROM devices, to expand on-board Program memory up to 20K bytes.
- R6532 RAM-Input/Output-Timer (RIOT) combination device. Multipurpose circuit for AIM 65 Monitor functions.
- Two R6522 Versatile Interface Adapter (VIA) devices, which support AIM 65 and user functions. Each VIA has two parallel and one serial 8-bit, bidirectional I/O ports, two 2-bit peripheral handshake control lines and two fully-programmable 16-bit interval timer/event counters.

BUILT-IN EXPANSION CAPABILITY
- 44-Pin Application Connector for peripheral add-ons
- 44-Pin Expansion Connector has full system bus
- Both connectors are KIM-1 compatible

TTY AND AUDIO CASSETTE INTERFACES
Standard interface to low-cost peripherals . . .
- 20 ma. current loop TTY interface
- Interface for two audio cassette recorders
- Two audio cassette formats: ASCII KIM-1 compatible and binary, blocked file assembler compatible

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Advanced features found only on larger systems . . .
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- Single keystroke commands
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ADVANCED INTERACTIVE MONITOR COMMANDS
- Major Function Entry
- Instruction Entry and Disassembly
- Display/Alter Registers and Memory
- Manipulate Breakpoints
- Control Instruction/Trace
- Control Peripheral Devices
- Call User-Defined Functions
- Comprehensive Text Editor

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- 4K Assembler—symbolic, two-pass , A65-010 $79.00
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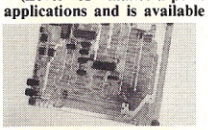
Level "A" Specifications

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an 8155 ROM-I/O—all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, *plus* generous prototyping space.

(Level "A" makes a perfect OEM controller for industrial applications and is available in a special Hex Version which can be programmed using the Netronics Hex Keypad/Display.)



Level "A" at $129.95 is a complete operating system, perfect for beginners, hobbiests, or industrial controller use.

PC Board: glass epoxy, plated through holes with solder mask • **I/O:** provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader ...provision for 24-pin DIP socket for hex keyboard/display...cassette tape recorder input...cassette tape recorder output...cassette tape control output...speaker output... LED output indicator on SOD (serial output) line...printer interface (less drivers)...total of four 8-bit plus one 6-bit I/O ports • **Crystal Frequency:** 6.144 MHz • **Control Switches:** reset and user (RST 7.5) interrupt...additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard • **Counter/Timer:** programmable, 14-bit binary • **System RAM:** 256 bytes located at F8ØØ, ideal for smaller systems and for use as an isolated stack area in expanded systems...RAM expandable to 64k via S-100 bus or 4K on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at FØØØ leaving ØØØØ free for user RAM/ROM. Features include tape load with labeling ...tape dump with labeling...examine/change contents of memory ...insert data...warm start...examine and change all registers...single step with register display at each break point, a debugging/training feature...go to execution address... move blocks of memory from one location to another...fill blocks of memory with a constant...display blocks of memory ...automatic baud rate selection...variable display line length control (1-255 characters/line)...channelized I/O monitor routine with 8-bit parallel output for high speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Version): Tape load with labeling... tape dump with labeling...examine/change contents of memory...insert data...warm start...examine and change all registers...single step with register display at each break point ...go to execution address. Level "A" in the *Hex Version* makes a perfect controller for industrial applications and can be programmed using the Netronics Hex Keypad/Display.

Hex Keypad/Display.

Hex Keypad/Display Specifications

Calculator type keypad with 24 system defined and 16 user defined keys. 6 digit calculator type display which displays full address plus data as well as register and status information.

Level "B" Specifications

Level"B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards and includes: address decoding for onboard 4k RAM expansion select-able in 4k blocks...address decoding for onboard 8k EPROM expansion selectable in 8k blocks...address and data bus drivers for onboard expansion...wait state generator (jumper selectable), to allow the use of slower memories...two separate 5 volt regulators.

Explorer/85 with Level "C" card cage.

Level "C" Specifications

Level "C" expands Explorer's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and cards are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card gold plated S-100 extension PC board which plugs into the motherboard. Just add required number of S-100 connectors

Level "D" Specifications

Level "D" provides 4k or RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from ØØØØ to EFFF in 4k blocks.

Level "E" Specifications

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for soon to be available RAM IC's (allowing for up to 12k of onboard RAM).

Order A Coordinated Explorer/85 Applications Pak!

Experimenter's Pak (SAVE $12.50)—Buy Level "A" and Hex Keypad/Display for **$199.90** and get FREE Intel 8085 user's manual plus FREE postage & handling!

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- ☐ **Explorer/85 Level "A" Kit** (Hex Version), **$129.95** plus $3 p&h.
- ☐ **8k Microsoft BASIC** on cassette tape, **$64.95** postpaid.
- ☐ **8k Microsoft BASIC in ROM Kit** (requires Levels "B," "D," and "E"), **$99.95** plus $2 p&h.
- ☐ **Level "B" (S-100) Kit, $49.95** plus $2 p&h.
- ☐ **Level "C" (S-100 6-card expander) Kit, $39.95** plus $2 p&h.
- ☐ **Level "D" (4k RAM) Kit, $69.95** plus $2 p&h.
- ☐ **Level "E" (EPROM/ROM) Kit, $5.95** plus 50¢ p&h.
- ☐ **Deluxe Steel Cabinet** for Explorer/85, **$49.95** plus $3 p&h.
- ☐ **ASCII Keyboard/Computer Terminal Kit** (features a full 128 character set, upper & lower case, full cursor control, 75 ohm video output convertible to baudot output, selectable baud rate, RS232-C or 20 ma. I/O, 32 or 64 character by 16 line formats, and can be used with either a CRT monitor or a TV set (if you have an RF modulator), **$149.95** plus $2.50 p&h.
- ☐ **Hex Keypad/Display Kit, $69.95** plus $2 p&h.
- ☐ **Deluxe Steel Cabinet** for ASCII Keyboard/Terminal, **$19.95** plus $2.50 p&h.
- ☐ **Power Supply Kit** (±8V @ 5 amps) in deluxe steel cabinet, **$39.95** plus $2 p&h.
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- ☐ **RF Modulator Kit** (allows you to use your TV set as a monitor), **$8.95** postpaid.
- ☐ **16k RAM Kit** (S-100 Board expands to 64k), **$199.95** plus $2 p&h.
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- ☐ **48K RAM Kit, $459.95** plus $2 p&h.
- ☐ **64k RAM Kit, $589.95** plus $2 p&h.
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- ☐ **Intel 8085 cpu User's Manual, $7.50** postpaid.
- ☐ **Special Computer Grade Cassette Tapes, $1.90** each or **3 for $5**, postpaid.
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- ☐ **Deluxe Case** for North Star Disk Drive, **$39.95** plus $2 p&h.
- ☐ **Experimenter's Pak** (see above), **$199.90** postpaid.
- ☐ **Student Pak** (see above), **$319.85** postpaid.
- ☐ **Engineering Pak** (see above), **$514.75** postpaid.
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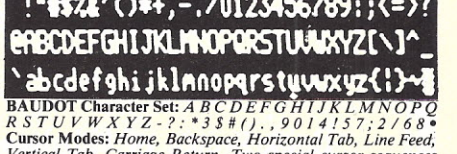

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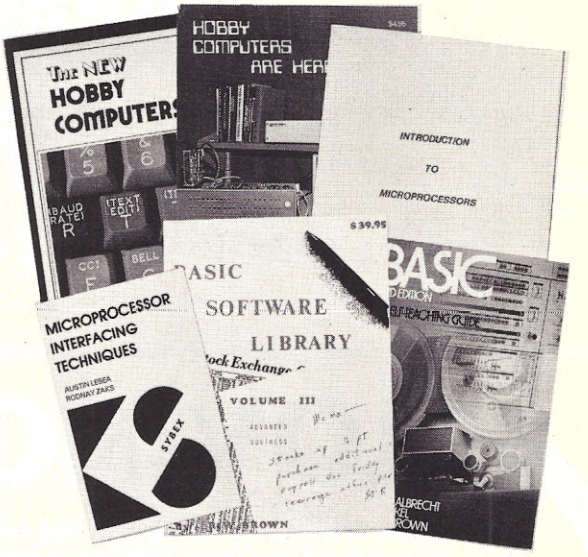

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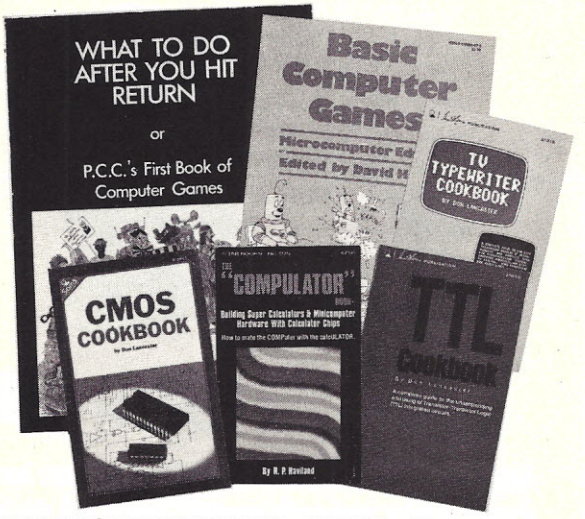

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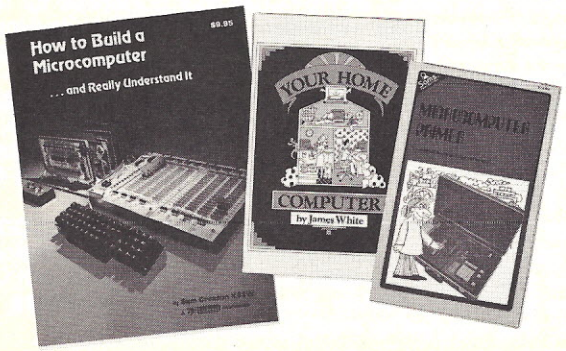

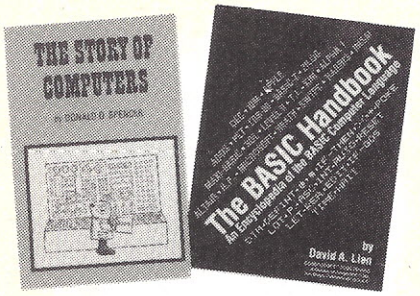

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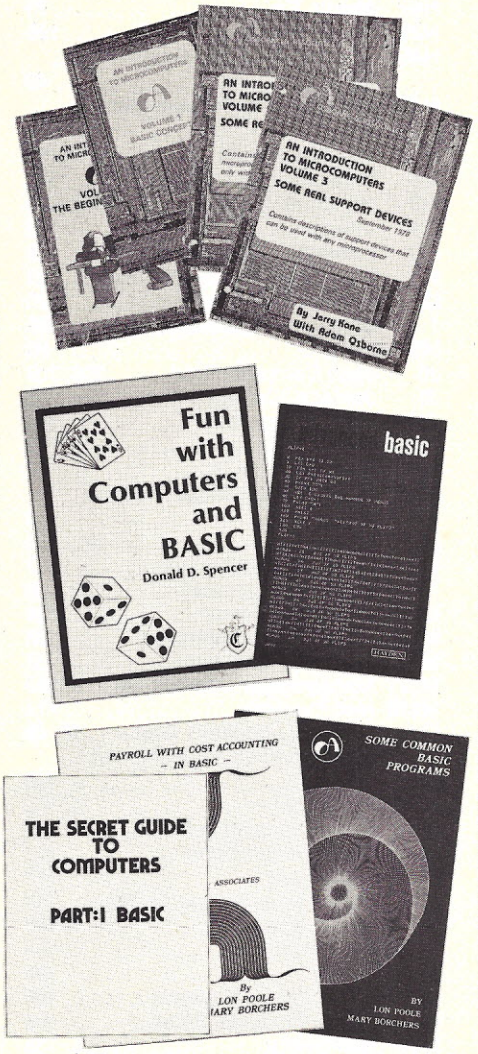

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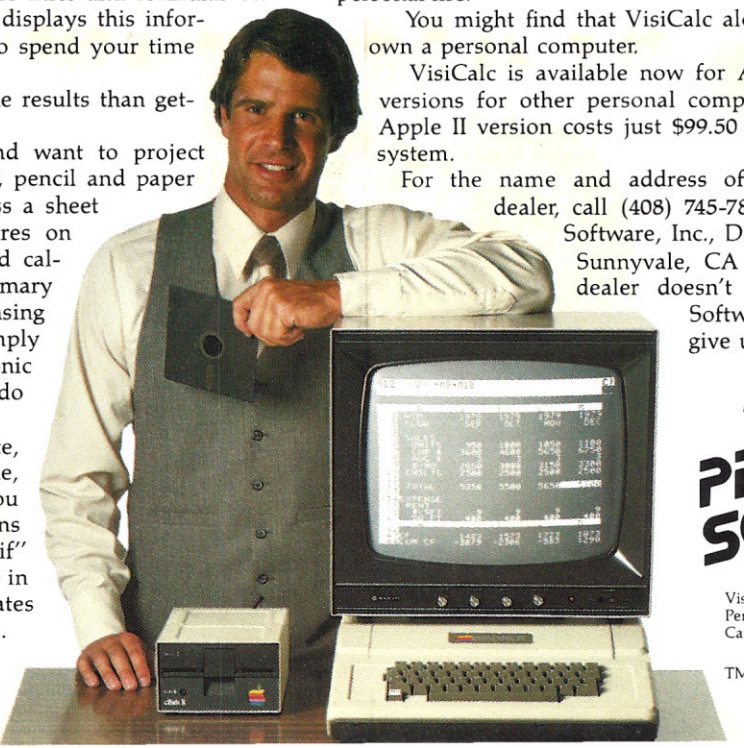

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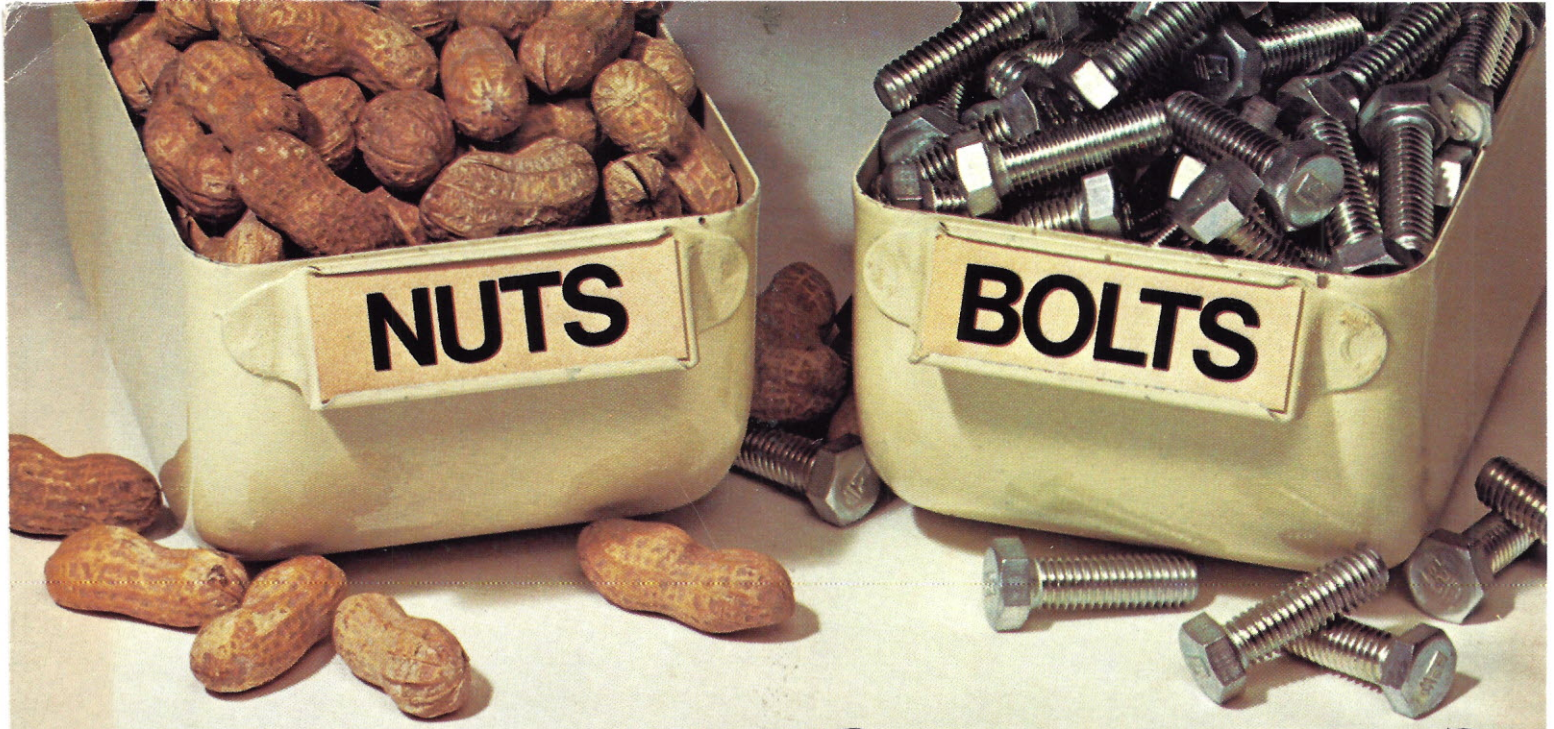

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